BYTE

FUTURE PCs: WILL INTEL TIGHTEN ITS GRIP? /p73

BYTE

HOT TECHNOLOGY
10 Virtual Private Networks Tested /p114

WEB SERVER SURPRISE: Microsoft Beats Netscape /p125

WINDOWS NT: Secure It! /p81

THE FUTURE OF INFORMATION TECHNOLOGY TODAY NOVEMBER 1997 www.byte.com

news/ DIGITAL REGAINS LEAD IN CHIP RACE... reviews/ NUMBER NINE 3D GRAPHICS, TRELLIX, & MORE...

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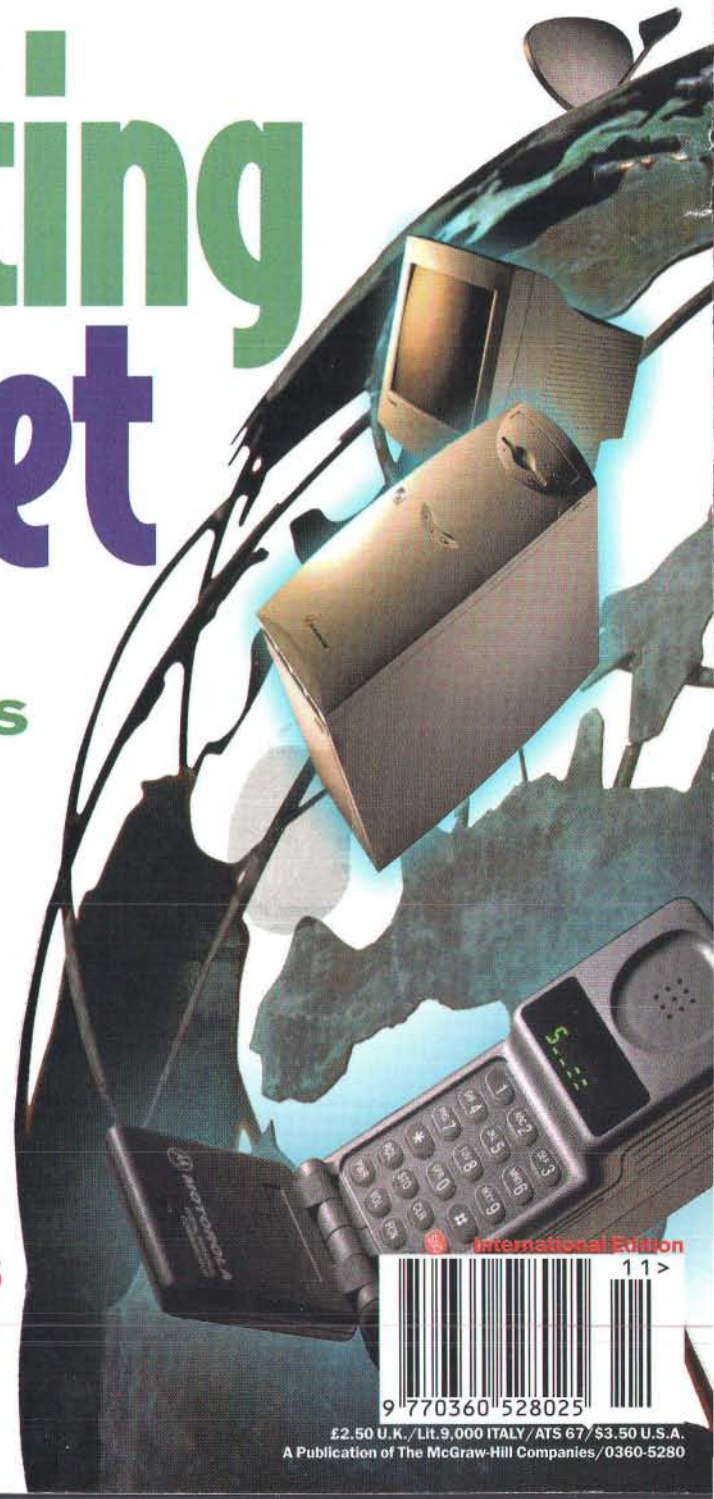

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November 1997, vol. 22, no. 11

THE ORBITING INTERNET

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By John Montgomery

58

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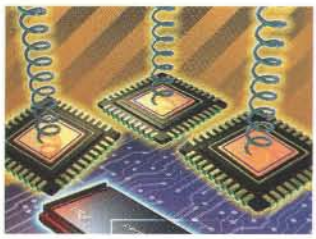


Socket to Me
73
By Tom R. Halfhill
The Pentium II's proprietary slots could mean trouble for Intel's competitors. What does it mean for users?

INTERNATIONAL

Broadband Choices
32IS 7
By Stella Kao

Bug Bounty Hunters
32IS 17
By Derek Jones

Greener Design
32IS 23
By E. Johnson and C. Seeberg-Elverfeldt

MANAGING DATA

Déjà Vu All Over Again
81
By Peter Mudge and Yobie Benjamin
Those holes in NT security sure look familiar. No wonder: Other OSes patched them years ago.

BUILDING NETWORK APPS

Components Battling Components
87
By Robert Richardson
Software plug-ins for Windows and Macintosh can do remarkable things. But they're also a source of conflict.

EDITORIAL

Raising the Java Standard 10

INBOX

13

BITS

600-MHz Alpha 18
Socket 7 Successor? 19
Power Mac Prevails 22
400-MHz Pentium II PCs 22
Next for Java Office Apps 24
Knuth's New Knuth 28

EVAL

GRAPHICS CARD

Number Nine's New Spin: Revolution 3D 33

Fast video playback and your choice of AGP or PCI.

DIGITAL CAMERA

CMOS Gets the Picture 34

Using a CMOS sensor, Sound Vision's SVmini-209 delivers high-quality pics at a low price.

AUTHORING SOFTWARE

A Watchamacallit for Words 37

Dan Bricklin's software for making hypertext documents.

LAB REPORTS

HARDWARE

26 No-Compromise Power Portables 106

By Michelle Campanale

We test MMX laptops with 166-MHz, 200-MHz, and 233-MHz CPUs. Plus: the first notebooks with Intel's Tillamook CPU.

SOFTWARE

Extend Your Net with VPNs 114

By Morgan Stern

We check out 10 virtual private network packages that let you use the Internet as your own private WAN.

WEB PROJECT

Cascading Style Sheets 97

By Jon Udell

CSS will change how Web designers work. Here are some ways to learn and use it.

JAVATALK

An Uncertain Discovery 101

By Rick Grehan

Metrowerks' Discover Programming will give you a decent introduction to Java, but it can be annoying.

CHAOS MANOR

Fooling Around with the Web 129

By Jerry Pournelle

New tools help build the Manor's Web site. Plus, a visit to the world's greatest graphics show: SIGGRAPH.

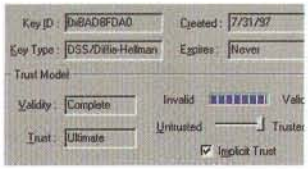
REVIEWS

SECURITY SOFTWARE

Cryptography Gets Personal 121

By Pete Loshin

Six products that promise to secure your data, both over the Internet and on your desktop.



WEB SERVERS

Battle of the Network Superservers 125

By Barry Nance

Netscape's SuiteSpot 3 vs. Microsoft's IIS 4.

WHAT'S NEW

159

Alpha workstations hit 600 MHz; Unix notebooks; and more new products.

IMPROBABLE

Something to STARE At 164

4-D images arrive (on our very own pages)! Senders of junk e-mail get hosed.

SERVICE

Reader Service
Inquiry Reply Cards 156A-B

Index to Advertisers
Alphabetical Order 156

Editorial Index by Company 158

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CORE

NETWORKS

Adjustable Cell Rates for ATM Networks 43

By William Stallings

A new ATM service compensates for network congestion.

OPERATING SYSTEMS

Autoconf Makes for Portable Software 45

By Bob Friesenhahn

Use of OS features and a freeware scripting utility solves application portability across various flavors of Unix.

DATABASES

The Quest to Standardize Metadata 47

By Stephen R. Gardner

Someday, disparate data-manipulation tools will be able to exchange information.

CPUs

Building the Virtual PC 51

By Eric Traut

A software emulator transforms the PowerPC into a Pentium PC.

PROGRAMMING

Dynamic HTML Explained, Part 1 53

By Rick Dobson

Dynamic objects and client-side processing mean better Web sites and better browsing.

CONTENTS BY PLATFORM

WINDOWS

A Chip off the Old Block . . 18
Digital's new 600-MHz 21164 Alpha CPU delivers the highest benchmark scores of any NT system we've seen.

x86 Vendors Unite Against Intel 19
AMD, Cyrix, and others are getting together to define a new PC architecture.

Future Watch 22
Coming next year: 400-MHz Pentium II PCs.

Number Nine's New Spin: Revolution 3D 33
This graphics card offers fast video playback and your choice of AGP or PCI.

A Watchamacallit for Words 37
Trellix is one of the first applications to support the ActiveX Hyperlinking Protocol.

Socket to Me 73
Intel's new CPU interfaces for its P6-class processors will make it tougher for rival chipmakers to compete. What does it mean for PC users?

Déjà Vu All Over Again 81
A look at NT's security holes, how they happen, and what you can do about them.

Components Battling Components 87
Everyone talks about DLL problems, but nobody's doing much about them.

26 No-Compromise Power Portables 106
We test Pentium laptops with 166-, 200-, and 233-MHz processors. Plus, some interesting findings about Tillamook machines.

MACINTOSH

Power Mac Prevails 22
Apple's new 9600/350 offers plenty of power, thanks to its 350-MHz 604e, but a whole new family of PowerPC CPUs is right around the corner.

Building the Virtual PC . . . 51
Connectix's emulator puts a Pentium PC inside a Power Mac. Here's how it works.

Components Battling Components 87
Extensions load extra function—and aggravation into the OS environment.

UNIX

Server Wars 26
Sun's new Enterprise 450 family of midrange servers erases the cost-of-ownership advantage claimed by NT-based workgroup machines.

Autoconf Makes for Portable Software 45
A free utility lets programmers build scripts that tailor an application for a specific Unix.

JAVA

Raising the Java Standard 10
The call for a standardized Java deserves qualified support and skeptical appraisal.

What's Next for Java Office Apps 24
Applix, Corel, and Lotus will bring new apps to market.

An Uncertain Discovery . . 101
Metrowerks' new Discover Programming package is a good starting point for Java development, but it has some annoying problems.

NETWORKING

Server Wars 26
Sun's Ultra Enterprise 450 delivers a peak speed of 1.7 GBps.

Adjustable Cell Rates for ATM Networks 43
Available Bit Rate informs the source system about network congestion.

Fiber in the Sky 58
A new generation of broadband satellites will bring multimegabit data rates to the entire globe soon. What is that going to mean for your networks?

Extend Your Net with VPNs 114
Virtual private networks let you use the Internet as your own WAN. We review 10.

INTERNET/WEB

The Man with No Domain Name 23
What happens when a Web service has its domain name removed from the root server?

10 Steps to Better Usability 32
Designing a Web site? Check out interface expert Jakob Nielsen's suggestions.

Dynamic HTML Explained, Part 1 53
DHTML permits dynamic styles, positioning, and content, as well as data binding to a browser and faster browsing through client-side processing.

Déjà Vu All Over Again 81
Windows NT boxes on the Internet are subject to a variety of attacks. Here's how to deal with the security hacks.

Cascading Style Sheets . . . 97
Balancing HTML purity and presentation pragmatism, BYTE's Webmaster experiments with CSS.

Extend Your Net with VPNs 114
Virtual private networks are designed to eliminate the hazards of private exchanges in public networks.

Cryptography Gets Personal 121
These six products help protect your data with encryption and digital signatures.

Battle of the Network Superservers 125
Netscape SuiteSpot 3 and Microsoft IIS 4 go another round. And the winner is . . . .

Fooling Around with the Web 129
Downloading updates over the Internet proves hazardous to the Chaos Manor network.

INDEX

AGP 33
ATM 43
Access framework 47
ActiveX 13, 37, 81
Alpha 18, 159
Authentication 81
Available Bit Rate 43
Broadband technology 58
CMOS sensors 34
CPUs 18, 51, 73, 106
Cascading Style Sheets . . 53, 97
Chips 18, 51, 106, 73
Code translation 51
Components 13, 87
Cryptography 114, 121
DVD RAM 18
Data communications 58
Databases 47
Denial of Service 81
Digital cameras 34, 129
Dynamic HTML (DHTML) 53, 97
Emulation 51
Encryption 114, 121
Firewalls 114
Graphics 33, 129, 159
Hypertext 37
Internet/Web 13, 53, 58, 81, 97, 114, 121, 125, 129, 159
Java 10, 18, 81, 101
Metadata 47
Mobile computing 58, 73, 106, 159
Motherboards 73
Networking 18, 43, 58, 81, 114, 121, 125
Notebooks 106, 159
Operating systems . . 45, 81, 129
PC architecture 73
PGP 121
Personal communications systems 58
Portability 45
Programming 18, 45, 51, 53, 97, 101, 159
S/MIME 121, 125
SEC slot 73
SOCKS 114
Satellites, broadband 58
Security . . . 13, 58, 81, 114, 121
Servers 18
Slot 1 . . . . . 18, 73
3-D graphics 33, 101, 164
Virtual PC 51
Virtual private networks . . . 114
Web design 53, 97, 129
Web servers 125

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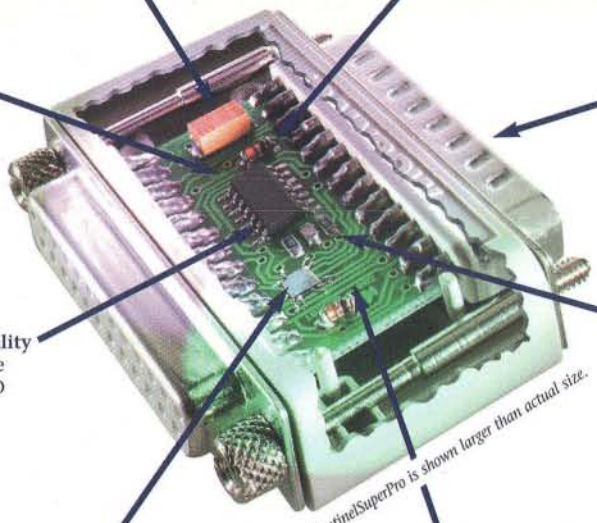

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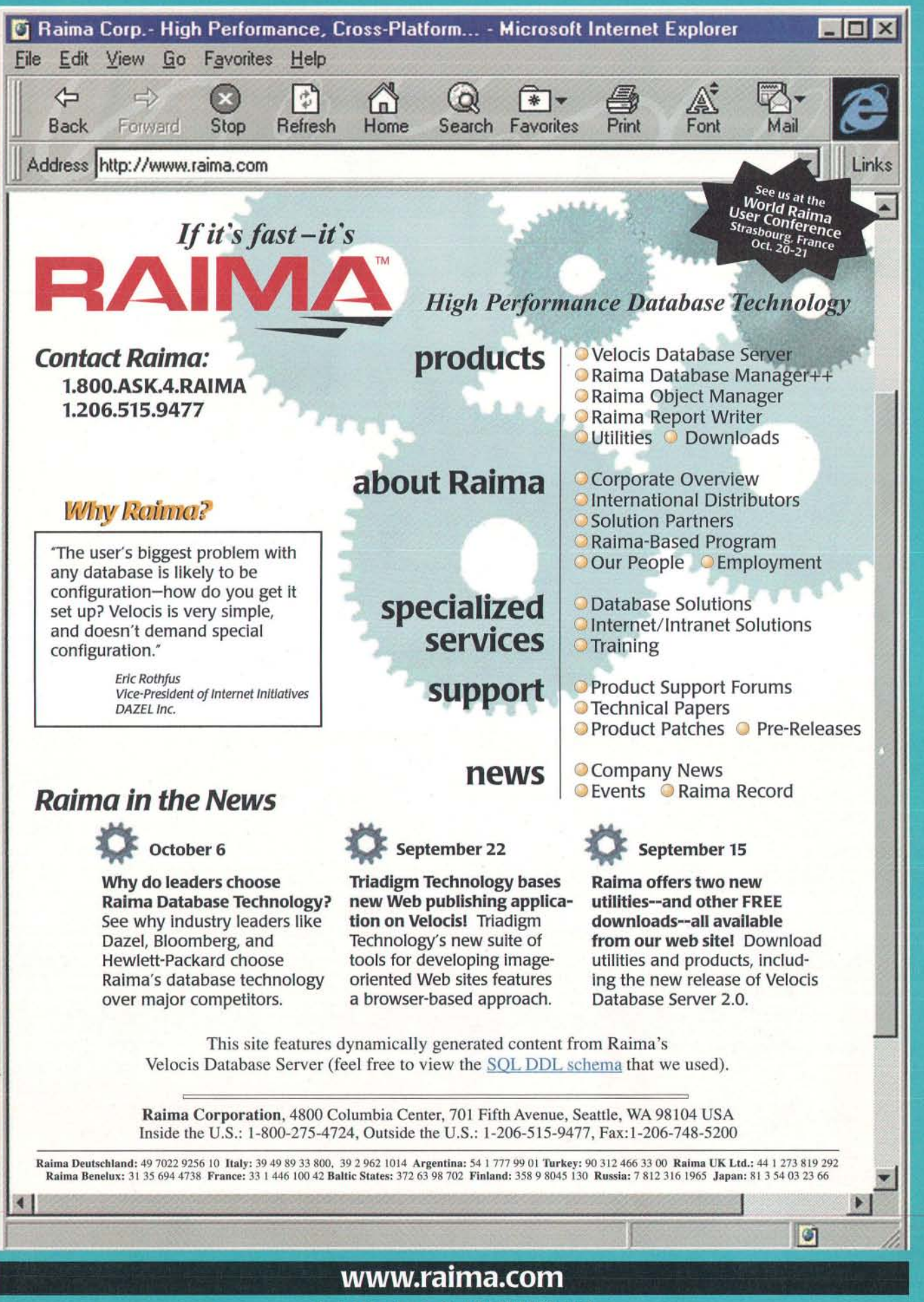

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Let's make things better.

Raising the Java Standard

We need many flavors, but one standard.

The recent call by Microsoft, Intel, Digital Equipment, and Compaq for a standardized Java deserves both qualified support and skeptical appraisal.

Let's take the skepticism first. Can you think of four companies with less inclination to openness? Windows and VMS have never been within a city block of a standards body. Intel used to be relatively open, for a chip company, but its latest moves with the Pentium II (see page 73) represent a classic closed door to competition. And while Compaq has developed more original technology than most PC companies, it hasn't developed a single open one that I can think of.

Nonetheless, even a broken clock is right twice a day. Mindful of this group's motives, let's look at the realities.

Why is the Internet bigger than Unix? Because you can depend on the Internet to be the same everywhere and you can't with Unix. Which way should Java evolve—like Unix or the Internet?

I vote for the Internet. So should Java advocates. For Java to spread beyond a dedicated core, both the software industry and corporate IS will have to believe it has a stable future. Right now, Java has not realized its dream of "write once, run everywhere." Plenty of small differences in virtual-machine implementations prevent that. Sun executives talk quietly about revoking Microsoft's license if it ships its version of the Java classes. Who will be left out in the cold then? The few hundred thousand Java users or the hundred million Windows users?

In a standards body, Sun will not get everything it hopes for, and neither will Microsoft. That's the point: Companies will have to cooperate to grow the pie. What do they have to lose? Let's examine the common myths:

Microsoft will hijack Java. Sure, it'll try. For over a year, the rap from Redmond has been "Java is a language, not a platform." Sounds a lot like "The Internet is a network, not a platform," a rap Microsoft was forced to retreat from. However, should Microsoft not come to its senses, there's nothing about a standardized Java that prevents Sun or anyone else from putting out its version of correctness and letting customers decide. If this technology is capable of standing up to the rigors of mission-critical computing, it's capable of surviving a standards body.

Standards slow the development process. Sure they do, in the same way that reading a map slows down the process of getting somewhere. It also prevents us from getting lost, a very likely outcome for Java if its advocates don't plan the route carefully. And what's the rush? Java is three years from being a mainstream application development platform. I'd like to think it'll be right, not just available, by then.

Java's too young to strangle in a standards body. Hmm, standards are too slow to achieve results, but too fast to allow growth.

Standards mute competition. Really? Tell that to IBM, loser of the 1980s network standards race between Ethernet and Token Ring. Submitting its Token Ring technology to the IEEE 802 committee did not prevent the other main 802-governed technology—Ethernet—from whipping IBM in the market. But it did allow customers committed to Token Ring to know where the technology was headed.

No other operating system vendor has ever submitted its product to a standards body, so why should Sun? No one else—at least since UCSD's p-code implementation—has claimed its product as a universal platform. Such a goal requires more than business as usual.

In a standards body, Sun will not get everything it hopes for, and neither will Microsoft.

Right now Sun and Microsoft are mirroring each other, trying to establish de facto standards. I support the Java Lobby's call to Microsoft and Intel to cease fractious activities. But I also think Java needs an independent standards body—perhaps a combination of the Java Lobby and vendors—dedicated to advancing the technology. If serious users are going to commit to Java, they're going to have to see maturity, stability, and reliability—from the vendors as well as from the products.

Mark Schlack

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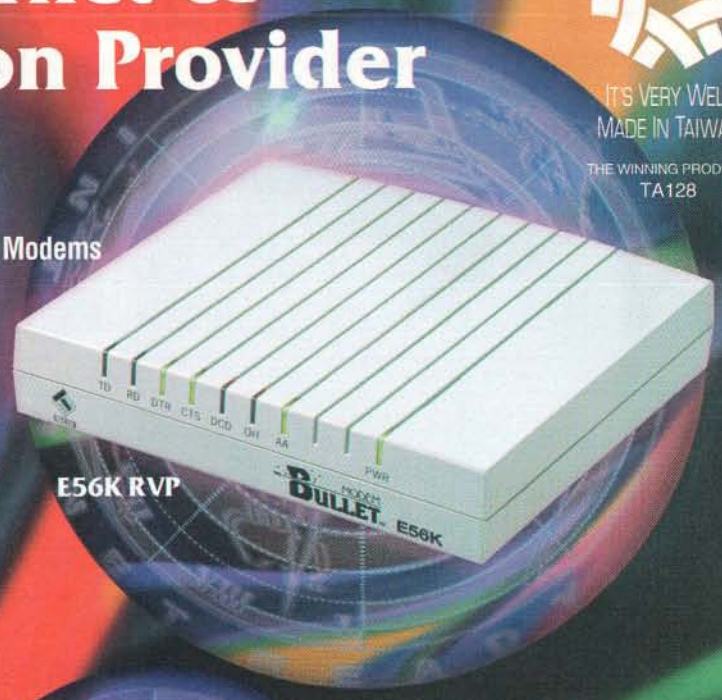

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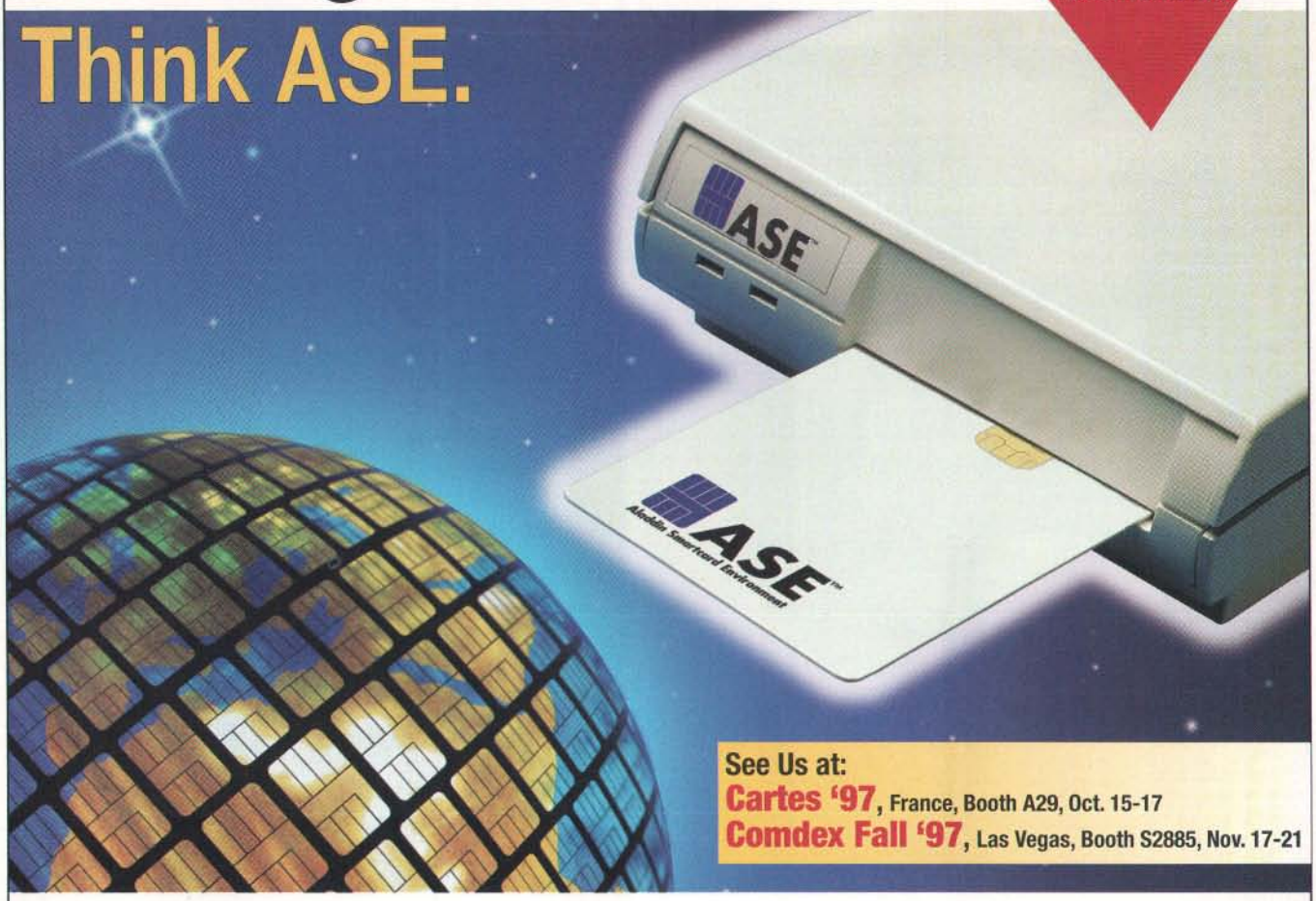

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ActiveX Files

The otherwise very good ActiveX cover story (September) includes some disinformation in David Linthicum's sidebar on security. Simply put, ActiveX has *no* security model. The infamous Exploder control that powers down a Windows PC was signed with a Verisign certified signature (http://www.halcyon.com/mclain/ActiveX). Microsoft claims that Authenticode, its code-signing framework, is a security model. It is not. It's an authentication framework.

"If a control destroys your system," you say, "at least you'll know whom to beat up." This is silly. What if the government passed a regulation that thieves must wear name tags if they break into a house when the owners are not present, and then the FBI rationalizes it by saying, "If a thief steals you blind when you're not home, at least you'll know whom to jail"? I don't think so.

Any hostile ActiveX control worth its salt will erase all traces of itself before proceeding with the rest of the dirty work. Since ActiveX is Win32-omnipotent, it can do anything. ActiveX may have its place in the developer's toolbox, but it's not a suitable model for executable content.

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I'm not sure I disagree with Mr. McGraw's observations. My intention was to explain the ActiveX security model, not promote it. As with any security subsystem, there are always methods to defeat it. We've seen this with Java, with the Internet, and I'm sure ActiveX is no exception. —David Linthicum

I want to thank the folks at BYTE for writing that excellent article, "ActiveX Demystified." There is, however, something that came to mind after reading it. Does ActiveX open Microsoft to a new era of unrelenting competition? Think about it. By dividing applications into objects that follow the Component Object Model (COM) spec, Microsoft has created many more targets subject to competition. It is difficult to unseat an entire suite of applications (as Corel has found out), but now, small and hungry software firms can target spelling checkers, TCP/IP handlers, peripheral drivers, and many other objects. Are we going the way of software widgets? Is Microsoft going the way of GM, where, in order to keep costs down, it will have to subcontract? The future that ActiveX will bring will be interesting indeed.

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P&S'ing for Dollars

We appreciate BYTE's recognition of the growth of publish and subscribe technology ("Publish or Perish," by Richard Hackathorn, September). However, we would like to clarify several points made in the article.

The statement that "no examples of monetary exchange with P&S have occurred" (page 66) dismisses the origin of publish/subscribe technology on Wall Street, where this model provides the infrastructure for billions of dollars in transactions. In fact, Open Horizon's Ambrosia product opens the door for electronic commerce beyond the trusted computer base of a LAN to the often unreliable environment of the Internet. Ambrosia offers guaranteed message delivery, transaction support, and comprehensive security around the core publish/subscribe messaging engine.

Contrary to the article's characterization of Ambrosia as based on CORBA, it is a pure publish/subscribe product implemented in Java. Ambrosia provides three levels of CORBA compliance to increase the flexibility of customer implementations, but it is not tied to CORBA. Finally, while you quoted our CEO, you left out our contact information: 650-869-2200; http://www.openhorizon.com.

Audrey Kalman
Director of marketing
Open Horizon, Inc.
South San Francisco, CA

While there are certainly billions of dollars being exchanged daily, these exchanges are done in systems carefully designed with limited sets of parties involved. There are no standards to allow economic exchange between independent consumers and producers. The subscribing process needs to be opened, as the Webcasting folks are doing.

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Economic exchange is critical to that openness. While the article might have implied that Open Horizon works only as a CORBA-based product, this was certainly not the intent. That said, CORBA and Java are not mutually exclusive.
—Richard Hackathorn

Web Groupware

Jon Udell's "HTML + NNTP = Groupware" (September Web Project) hit on several important points but didn't mention that the Web was originally designed to do what he's describing: collaborative authoring. When Tim Berners-Lee invented this stuff, he was trying to provide a way for people to collaborate on document authoring so that dispersed groups could write scientific papers. That's why the little-known and even less-used CHECKIN and CHECKOUT methods are part of the HTTP standard. POST was meant to allow people to post articles and papers to newsgroups; it wasn't meant to receive results from a form as it is now used.

The only advantage of using NNTP/INND over the Web is that replication is better supported (this is where Lotus Notes scores). How about doing all this stuff using a Web browser and a Java applet that would add the relevant headers to an HTTP POST request so that you wouldn't have to split the subject line into name, company, and keywords? This would allow you to make the user interface more intuitive, and you wouldn't get misformed subject lines. The display of threading wouldn't be as easy (newsreaders have threading built in), but if Lotus Domino can do outlining "twisties" on the fly, why can't a Web server script? Doing it this way removes the problem of old text-only news readers, and we're back to a thin vanilla client with any smarts being added as Java applets that get downloaded and updated when required, plus some server-side scripting for sorting, outlining, and thread displaying.
Hubert Matthews
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Very true about the Web's origins. And yet oddly, the Web has emerged into popular consciousness as primarily a read-only medium. Meanwhile, the Usenet has become a read-write medium for the masses. My strategy is to go with the flow.

The biggest advantage of using NNTP/INND is: no server-side programming required at all to deal with a basic document database, with discussions, with binary attachments, and now even with HTML. It wasn't planned this way, but the combo of NNTP servers and clients has become in a way more useful than the combo of HTTP servers and clients, that is, for the particular class of application to which I'm trying to draw attention. This is a very large, important class of application.

A Web server script can do those things you mention. I've written lots of things like that. But I'm trying to focus on what can be done with out-of-the-box tools and no programming. —Jon Udell

Other Interfaces

Your article on network user interfaces ("Good-Bye, GUI—Hello, NUI," August) left out one important NUI. Silicon Graphics' Indigo Magic has had for about a year now many of the features other vendors will be implementing in the "near future," such as URLs directly on the desktop, a network clipboard, and a file manager that can show FTP sites or other URLs directly and lets

you drag and drop a page to a local file.
Kristoffer Lawson
setok@fishpool.com

Here's another interface you might want to check out: the KDE (as in Kool Desktop Environment) project for X Window—but mostly Linux—systems. Based on the Qt widget set by Troll Tech, KDE is a free GUI/NUI undergoing development by a team of programmers around the world. At the heart of KDE is Kfm, the file manager. It's network-oriented and can view any file tree that can be described in URL format. It can already render most HTML, and the next major version, Kfm II, will also function as a Web browser (it will even support frames). There are other applications in KDE, too, including simple editors, a font browser, and a sound player. At the moment, the software is still in alpha phase, but it's remarkably stable, and I use it virtually full-time now. If you want to read more, go to http://www.kde.org/.
John McNulty
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Improbable Products, or If We Had a Million

Man, I am sitting on an S.F.-to-Boston flight and cannot stop laughing. September's Improbable item about Stochastic Cleaner—the program that "cleans your hard disk of all the clutter that you probably don't need"—is just great. Keep up the good work.
Steve Butcher
steveb@collectivetech.com

Glad you enjoyed it. Many readers have written us to find out how they can actually buy the products covered in Improbable; for example, we received virtually millions of letters about Cyber Babewatch (August), including one from a clinic that dangled before us the possibility of real cash expenditure. But until those fussy, ROI-obsessed venture capitalists start returning our calls, the items mentioned on the end page will have to remain on the drawing board in Marc Abraham's mind.
—Editors

Hot Plug Today

While you did a solid job of describing how Hot Plug PCI technology works, and the role it can play in reducing server downtime, you left out information regarding the current availability of compliant products ("Hot Plug Will Deliver Higher Availability," July Bits). NetFrame Systems has been shipping Hot Plug PCI systems, boards, and device drivers since 1996, when the company introduced its ClusterSystem 9016 server. Last June we introduced the ClusterSystem 9008, which offers eight individually hot-

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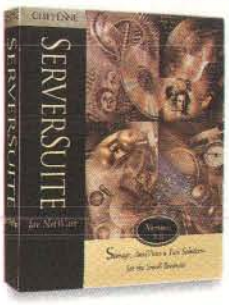

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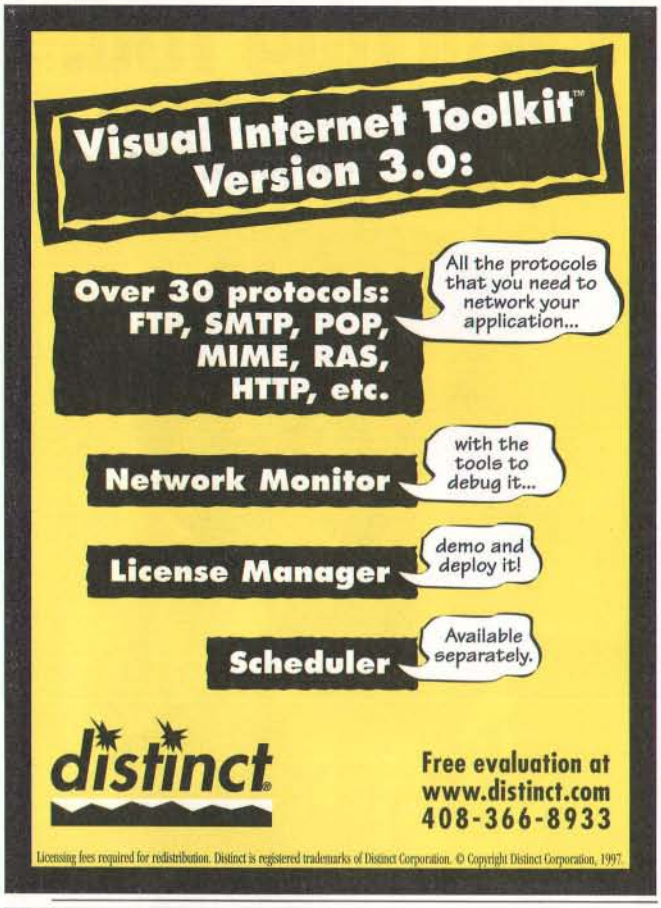

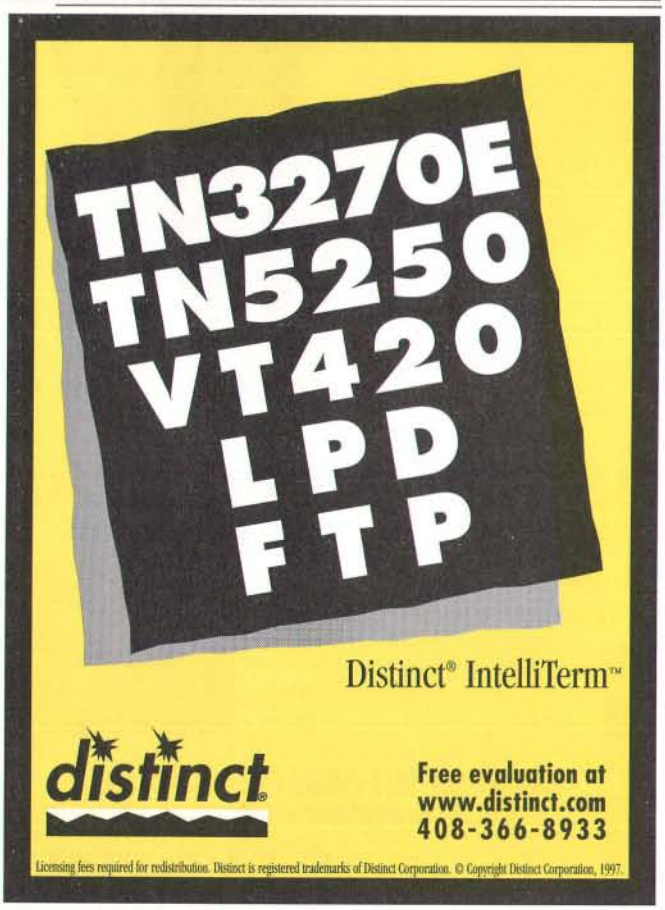

pluggable PCI card slots.

NetFrame has tested its systems with the proposed Hot Plug PCI standard you wrote about and recently announced that both the 9016 and the 9008 are fully compliant with the most recent draft of the specification. NetFrame is committed to ensuring that its servers will be compliant with the finalized specification, due later this year.

Marcia Speece
Director of corporate communications
NetFrame Systems
Milpitas, CA
http://www.netframe.com

FIXES

We used Visual C++ version 4.2, not 4.3, as part of our benchmark tests of Pentium II PCs (September Hardware Lab Report).

Zyxel's omni.net (October Hardware Lab Report) is 17.9 (W) x 13.1 (L) x 3.8 (H) centimeters, not inches.

Wright Strategies' FormLogic 3.0 development kit (September What's New, page 145) costs $250 per user for 75 users. The per-user price goes down incrementally as the number of seats goes up.

COMING UP IN DECEMBER

COVER STORY

Microprocessor Update

BYTE's annual analysis of the microprocessors that will be powering systems in the next year.

MANAGING DATA

Enterprise Management Frameworks

Computer Associates, Tivoli, and a handful of others have created systems that help you monitor and administer everything on your network. Here's how they work, what they do, and what they can't do.

BUILDING NETWORK APPLICATIONS

Microsoft COM 3

A look at the recently announced changes to Microsoft's Component Object Model.

Editors' Choice Awards

Our pick of the most important products of the year.

REVIEWS

Web Development Kits

We round up high-powered software for developing and deploying custom Web applications.

BeOS

We get our hands on this multimedia-rich OS and analyze its chances of being an alternative to Apple's upcoming Rhapsody.

NT 4.0 Enterprise Edition

Until 5.0 arrives, the place to get Microsoft's latest NT-based networking technologies is NT 4 Enterprise Edition. Our tests will help you decide if it's worth the upgrade.

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November 19, 1996
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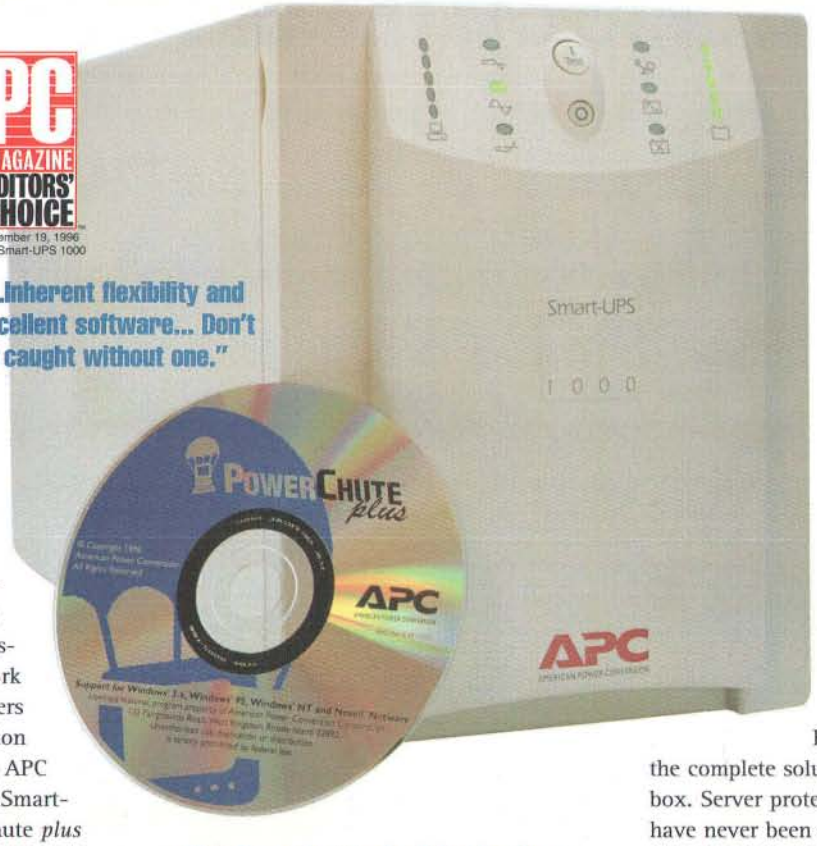

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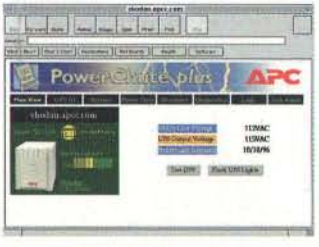

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A Chip off the Old Block

Digital has reestablished Alpha's CPU performance lead over Intel at the high end. Its next move: Another stab at the desktop PC space.

Now that the new 600-MHz 21164 delivers a considerable advantage in raw performance over Intel's Pentium II, Digital will try again to penetrate a market that has so far eluded its Alpha processor: the desktop PC.

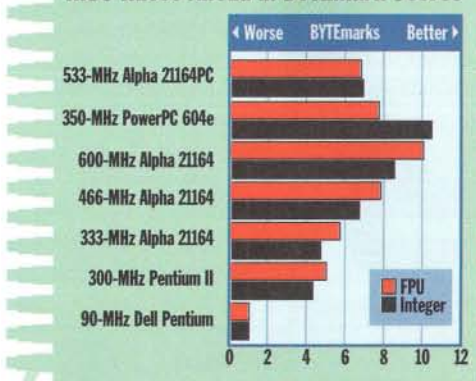
Like other RISC CPU vendors, Digital was embarrassed in late 1995 when Intel's Pentium Pro caught up to the Alpha, at least in integer performance. However, Digital has reestablished its performance lead at the high end: A new 600-MHz 21164 Alpha-based system from Polywell, which BYTE recently tested, trounced 300-MHz Pentium II–based systems in our CPU-/FPU-intensive BYTEmark tests. The 350-MHz 604e also does quite well on this test.

Now Digital is readying a new CPU, the 21164PC (see "Alpha Arrives at the Desktop," May BYTE), which costs less than the 21164 but delivers almost as much performance. The 21164PC targets desktop PCs costing $2500 to $3000, a price that's still at the high end of the mainstream PC market but much less than the $10,000 or so that systems using the 600-MHz 21164 now cost. The first 21164PC-based systems were expected to start shipping this fall, according to officials at Digital.

With the 21164PC, Digital retained the 21164's basic core but did several things to reduce costs, including moving the 21164's modest (96-KB) Level 2 cache off-chip and reducing the pin count by eliminating support for multiple processors and limiting the size of the L2 cache to a maximum of 4 MB (down from 64 MB).

The 21164PC processor costs $495 in OEM quantities for the 533-MHz model and just $295 for the 400-MHz version. At those prices, the chip competes with both the Pentium and the Pentium II, although the 21164PC's chip set, the 21174, costs about $60 more than Intel's 440LX Accelerated Graphics Port (AGP) set. The 21164PC's motion-video instruction set enables it to perform streaming video compression (e.g., full-frame and full-motion digital videodisc [DVD] acceleration) that can't be done on the x86 architecture without additional hardware, such as a graphics accelerator with DVD support, Digital officials say.

The 21164PC isn't Digital's first attempt to enter the RISC PC market. The company's 21066, a less expensive version of the 21064 Alpha CPU, fared poorly and illustrates the many reasons why penetrating the mainstream PC market is such an uphill battle for a RISC vendor. At the time, Digital officials blamed the 21066's tepid reception on a lack of native Alpha NT applications and other market factors. But analysts say the main reason the 21066 sank was due to poor price/performance. Results from running our BYTEmarks on a reference system based on the 21164PC indicate that the new CPU will deliver plenty of performance for the dollar: It beats the 300-MHz Pentium II in both integer and floating-point performance.



Alpha chips are still dogged by nagging questions about the number of native applications available for the platform, although Digital and its partners have done much to improve this situation since the days of the 21064. Today, Digital claims 2000 to 2500 native applications are available for the platform, and it's pushing the creation of more by offering hardware discounts for software vendors and by helping vendors port their applications to Alpha. "We have been driving the porting of applications to Alpha for all OSes—with the focus on NT, and Unix a close second," says Aaron Bauch, manager of technical marketing for Digital's Alpha Microprocessor. Another technology, Digital's FX!32 emulation/translation software, improves the performance of native x86 programs when executing on Alpha NT hardware.

Nevertheless, there are some holes. For example, Microsoft currently has native Alpha versions of Excel 97 and Word 97, but none of any other applications in its Office family. Getting more Alphas onto more desktops will make the platform a more

attractive one for software developers to target.

Many Alpha-powered systems are still geared toward high-end applications, such as animation, graphics production, and databases, and most smaller companies apparently don't need all that power at the prices Alpha systems command (see the Survey on page 24). Bauch believes that this will change with the continued evolution of Windows NT. "Our advantage in the NT marketplace is performance and the longevity of a system," he explains.

By the first half of 1998, Digital will be ready to release a new CPU, the 21264. This is to be the company's flagship processor; it will target high-performance servers and workstations and offer both uniprocessor and multiprocessor configurations.

In the past, Digital has simplified the CPU core while gunning for the highest speed. The new 21264, which features a complex, out-of-order CPU core, will process up to 80 instructions at once. It has a bandwidth several times higher than that of previous chips, channeling up to 5.3 GBps of cache data and 2.6 GBps of main memory into the demanding new processor core. The new 21264 will start life at 500 MHz, still far ahead of any competitors in terms of speed. And you can expect Digital to release a PC version of the 21264, according to Pippa Jollie, product manager for the 21164PC.

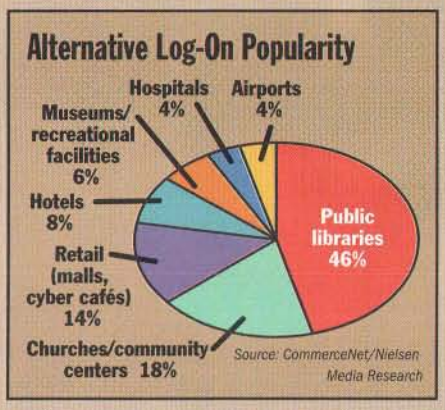
Digital is trying to emulate the success of x86 manufacturers in building a base of OEM customers by making the technology more readily available. During the past few years, for example, Mitsubishi and Samsung have begun producing Alpha chips, VLSI Technology has begun producing third-party core logic (and it might release a less expensive alternative to the 21174 chip set), hundreds of options from third-party hardware vendors' add-in cards now exist, and 2000-plus independent software vendors now support the platform.

What's missing—and what Digital covets—is a design win for the 21164PC with a top-tier PC vendor, such as Compaq or Dell. "It's always been a primary goal to get a tier-1 company," says Digital's Jollie. Tier 1 vendors are interested, she says, but they're currently in wait-and-see mode. "With the 21164PC, we are providing vendors a product that we hope they will adopt. I would be thrilled if they did." **–Jason K. Krause**

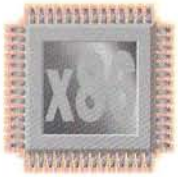
Geek Mystique

The Internet's Busting Out All Over

The number of people who today regularly access the Internet through alternative points of access has almost tripled since spring 1996. These alternative points of access include locales other than home, school, or the office—such as museums, libraries, retail outfits (including malls and cyber cafés), recreational facilities, churches, hospitals, and community centers. In 1996, 1.5 percent of the survey respondents claimed to access the Internet through alternative points; that's now up to 4 percent, suggesting that the Internet's importance in our daily life is increasing.



x86 Vendors Unite Against Intel



Foiled by Intel's rigid patents on Slot 1, rival vendors of x86 chips are working on a new CPU interface to succeed the widely used Socket 7. The higher-bandwidth interface would be an open alternative to Intel's proprietary sockets and slots, but it could split the PC system architecture into incompatible standards.

Cyrix officials confirm they've held discussions with AMD and other companies about a successor to Socket 7. Socket 7 is the 296-pin CPU socket used by all P5-class x86 chips, including Intel's Pentium processors, the AMD K5 and K6, the Cyrix 6x86 and 6x86MX, and the Centaur IDT-C6. Intel's competitors need an alternative because they can't license the patented bus protocols for Intel's P6-class processors.

All of Intel's P6 processors (including the Pentium Pro, the Pentium II, and the forthcoming Deschutes) require the same basic bus protocols, although the physical interfaces vary. The Pentium Pro uses Socket 8, the Pentium II uses Slot 1, and some future Pentium II processors will use Slot 2. Mobile versions of the Pentium II use still another proprietary interface that's a miniaturized variation on Slot 1. Motherboard makers can put Intel's CPU interfaces on their boards, but Intel won't share the technology with rival vendors of x86 processors, although it has licensed it to some core-logic chip-set vendors.

"If we adopt a proprietary solution, it will only help Intel win," says Stan Swearingen, product management director at Cyrix. "We believe the industry wants that to be an open socket. We're already talking to chip-set vendors, AMD, and other companies to define a new interface," he adds.

The interface would probably debut in 1999. Cyrix, AMD, and Centaur agree that Socket 7 will remain popular at least through 1998, and possibly beyond. Although it has less bandwidth than Intel's interfaces, it's fast enough for mainstream desktops and servers.

Vendors are currently working to ex-

Contents

Apple Pounds Clones 22

Sun's 450 Server Takes Aim at Wintel 26

Compaq Counters Sun's 450 28

How to Design Better Interfaces 32

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tend the life of Socket 7 in several ways. This fall, AMD will likely announce a new K6 processor with a larger Level 1 (L1) cache. Centaur plans to ship next year a new version of the IDT-C6 that will integrate the Level 2 (L2) cache. Other possible stopgaps include CPU daughtercards that plug into Socket 7 (see "Socket to Me" on page 73).

Meanwhile, Intel isn't standing still. In August, it announced a new Pentium Pro processor with 1 MB of L2 cache—twice the maximum cache size of earlier Pentium Pro chips. Intel plans to introduce the Deschutes version of the Pentium II in mid-1998. Deschutes will be the first Pentium II chip fabricated on a 0.25-micron process, and it will eventually replace today's 0.35-micron Pentium II chips (for more information, see "Future Watch," below).

Slot 2 is a higher-performance version of Slot 1 that will run at a bus frequency of at least 100 MHz and support larger single-edge contact (SEC) cartridges. These cartridges have room for bigger L2 caches. Intel is aiming Slot 2 at higher-end desktops and servers, leaving Slot 1 for mainstream systems.

Even if Intel's competitors can rally around an alternative interface, it will put many companies and users in a quandary. Today it's possible to make a Socket 7 motherboard that works with anybody's P5-class processor. But manufacturers say it costs too much to construct a motherboard with two different CPU interfaces because they're electrically incompatible. Vendors would have to either create two versions of every product or choose sides.

The result could be two competing PC architectures: Intel and non-Intel. And since Intel is the industry's leading supplier of CPUs, motherboards, and chip sets, the non-Intel faction faces an uphill battle to establish an open standard.

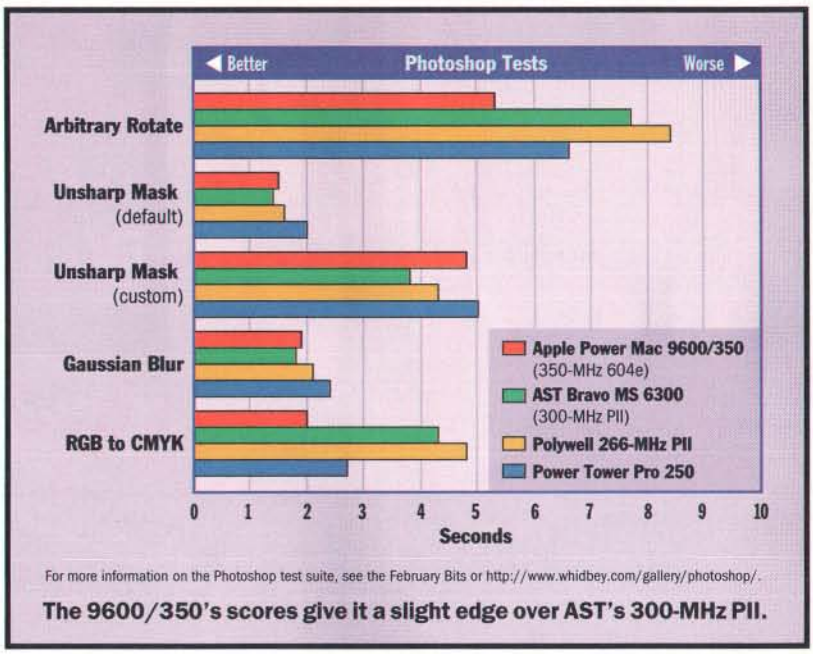
–Tom R. Halfhill

Power Mac Prevails (with an Asterisk)

Apple's Power Macintosh 9600/350 uses the 350-MHz 604e CPU.

Thanks to its 350-MHz PowerPC 604e CPU, faster cache, and other improvements, Apple's new Power Macintosh 9600/350 delivers excellent performance. But its status as the "fastest Mac" comes with an asterisk.

Thanks to turmoil surrounding Mac OS licensing and Apple's acquisition of Power Computing, the competition for the 9600/350 is now a lot thinner. With Motorola pulling out of the Mac-clone market and the Power Computing buy-out, Apple doesn't have to worry as much about clone vendors further eroding its market share by introducing



For more information on the Photoshop test suite, see the February Bits or http://www.whidbey.com/gallery/photoshop/.

The 9600/350's scores give it a slight edge over AST's 300-MHz PII.

Future Watch

Coming in 1998: 400-MHz PII PCs

By this time next year, Pentium II chips should be available at speeds of 400 MHz or higher, along with Pentium II versions for systems that have more than two processors and for notebooks.

Intel says the Deschutes version of the Pentium II will debut at 333 MHz early next year. It will be built on a 0.25-micron process and will reach speeds of 450 MHz by the end of next year. Sometime during the first half of 1998, Intel will release a 350- or 400-MHz version of the Pentium II that will support a 100-MHz system bus. This chip, which will sit in a Slot 1 cartridge, will target desktops, entry-level servers, and workstations.

Around midyear, the company will introduce Pentium II processors that plug into Slot 2, which is intended for servers and accommodates a larger Level 2 cache that runs at the core clock speed of the processor. Slot 2 configurations will support a 100-MHz system bus next year, and servers based on it will scale to a minimum of four processors, company officials said.

Intel will introduce Pentium II processors for portables during the first half of 1998. These chips will be available in either a modified cartridge design (similar to slots but significantly smaller) or the Mobile Module.

new, powerful Macs based on the upcoming G3 series (e.g., the PowerPC 750).

Another chip, Exponential's 533-MHz X704 CPU, is also no longer an option: After falling short of its target clock speeds and delivery schedule, Exponential killed the X704 and is suing Apple for breach of contract, interference, and other actions. At press time, the only Mac-clone vendor that had licensed Apple's Mac OS System 8 was Umax Computer.

For now, Apple's top high-end system is based on the 604e; G3-based systems from the company will probably ship this fall. But the 9600/350 offers plenty of performance for power users. In addition to its 350-MHz CPU, the system has a 1-MB secondary (L2) cache and a new cache controller that enables the CPU to talk to the L2 cache at 100 MHz. Due to the cache design, known as an in-line cache, the PowerPC doesn't have to wait as long for data as it would if the CPU accessed the L2 at the same speed as the 50-MHz system bus (CPU to main memory). The 604e's increase in megahertz is due to the new 0.25-micron process.

The 9600/350 delivered the highest integer performance of any desktop system BYTE has tested using our CPU/FPU BYTEmark tests. You can see how it rates against other systems on page 18. The BYTEmarks measure raw CPU performance and do not test other system components, such as hard drive and video adapter. In our suite of cross-platform Photoshop tests, the Power Mac beats a 300-MHz Pentium II decisively in the arbitrary rotate test, but the other scores are closer.

The PowerPC 750 (code-named Arthur), the first processor slated to come from the new G3 PowerPC family, will initially run slower (275 MHz) than the fastest 604e. But thanks to a separate L2 cache bus and a small die size, the G3 series promises better performance at a lower price: A system from Power Computing with a 275-MHz G3 scored 9.4 and 6.1 in the BYTEmark integer and FPU tests, respectively. That system won't ship now, although Apple might sell it in the future.

But although Apple's decided that competition from clones wasn't such a good idea, it still must compete against Wintel, and, compared to some Pentium II PCs, the 9600/350 is pricey: with 64 MB of RAM, a 4-GB hard drive, a 24X CD-ROM, a Zip drive, and a video card with 8 MB, it's about $5400. AST's similarly configured Bravo MS 6300 is $2950. **–Dave Andrews**

Bug of the Month

The Man With No Domain Name

Dennis Gaughan must have looked forlorn, standing in the pouring rain, pounding on Network Solutions' door and pleading with security to put him in touch with tech support. But what else was there to do? His domain name was gone.

Sometime Saturday afternoon, August 2, WebCom, a Web and e-mail service that hosts Gaughan's intranet site, had its domain name removed from the root servers of Network Solutions, which manages the domain-registration system for the Internet. The source of the problem was a bug in a script that Network Solutions was running over the weekend while cleaning its databases, erroneously deactivating WebCom's domain. In the aftermath of the crash, WebCom, which is based in California, was unable to contact Herndon, Virginia–based Network Solutions to find out what had happened. Many analysts say the WebCom incident is yet another in a string of snafus that highlight the Internet's immaturity for hosting bet-your-business applications.

"Network Solutions is a single point of failure for the Internet, yet there's no 24-hour hot line to contact them if something goes down," says Thomas Leavitt, executive vice president of WebCom. Network Solutions claims to have a direct line for contacting system administrators at any time, but it's not a general hot line, and company officials asked BYTE not to publish the number for the general public. Leavitt was unaware of this number at the time that his Web site went down.

In the wake of the domain-name crisis, WebCom officials were able to find a WebCom user, Gaughan, who lived in the same area as Network Solutions' facilities. "I went to Network Solutions' facility in Herndon," says Gaughan. "I knew it wasn't the InterNIC engineering center, just an administrative office, but I wanted to get their security to put me in touch with someone who could help."

Gaughan's confrontation with security happened to coincide with the first thunderstorm in the area in 3½ months, and he got soaked for his efforts, but Network Solutions called in some staff members and ran an emergency regeneration of the root server Zone file to restore accessibility of WebCom's domain. –J. K. K.

Send yours to jason_krause@mgh.com!

DVD RAM Splits, But Products Still Coming

Just when it looked as if DVD RAM was sailing along smoothly as the next standard for writable storage, a rift in the group of key vendors backing the standard has created serious questions for end users. A trio of companies—Hewlett-Packard, Philips, and Sony—have decided to come up with an alternative format to DVD RAM, the recordable version of DVD video.

The new format, which will be called DVD+RW, is incompatible with the one approved by the DVD Consortium and differs largely in its higher recording capacity, as well as in its recording technology. Nevertheless, major companies, such as Toshiba, say they're on track to release products based on the original standard by the end of this year.

DVD+RW will handle 3 GB on a single-sided disk, and twice that on a double-sided disk, versus 2.6 GB per side for the Consortium DVD RAM standard. At press time, Mitsubishi, Ricoh, and Yamaha had all signed on to the renegade standard, providing momentum for this proposal.

Could the split in the DVD RAM standard be a replay of the infamous Beta-versus-VHS battle? Possibly, but it almost certainly portends unsettled times for buyers of DVD RAM products. Several other major players, such as NEC and Toshiba, have not announced any intent to support this new standard. "Toshiba is pretty much in line with the original schedule to commercialize this technol-

ogy and introduce products into the market by the end of 1997," says Ken Ishihara, vice president for Toshiba America. "We are currently not going with those three companies and are [not] working with that [other] format."

Werner Glinka, director of marketing for Hitachi's Storage Products Group, says his company has already delivered samples of its GF-1000 drive to key customers, who will sell Hitachi's drives under their own labels. Like Toshiba, Hitachi's drive is based on the original standard.

Glinka admits that the rival standard provides for slightly more storage space at first, but he says the DVD Consortium has announced plans to provide up to 50 GB of storage space over the next 10 years. "What counts in the end is broad availability of products from a number of companies," he says. "Broad availability will solidify the standard." Sony isn't currently saying when it will ship drives that are based on the new format—only that it will support it.

Why the split? Sources who wish to remain unnamed said there are several possible reasons. One is that Sony was unhappy with its cut of the royalties from the original standard. Others say Philips and HP wish to cast confusion in the market so that more people will buy their multisession recordable CD drives.

Whatever the reason, the rift might give even more impetus to solutions such as Iomega's Zip drive, which stores less data than DVD per disc, but more than a floppy. Unless you must have the first writable DVD product, it may be better to wait and see for sure. **–Jon Pepper**

What's Next for Java Office Apps

Amid a sea of changing strategy and concerns over Java's direction, software vendors say they will continue to bring Java business applications to market. Software developers working in the Java space must juggle the evolving Java platform with the realities of bandwidth availability and end users' expectations.

Java Office Apps Road Map

Applix: Will release this year an NT server version of Anyware Office (which delivers a word processor, a graphics-capable spreadsheet, an e-mail client, and HTML authoring to Java-enabled clients) to complement current Unix servers. Also planned: a new presentation module and a Java client for the TM1 OLAP program. (508-870-0300; http://www.applix.com)

Corel: Will release in mid-1998 "Remagen" (which lets Java-enabled clients access existing Corel WordPerfect Suite 8 or other office suites running on a server) and "Alta" (a universal in-box, calendar/scheduler, ad hoc work-flow, task-management, and data access/analysis package), plus technology for dynamic UI and application assembly to make programs run better over networks. (613-728-0826; http://www.corel.com)

Lotus: Will release this year the "Kona" family (which includes a NUI and data-access, spreadsheet, word processor, charting, project-scheduling, presentation-graphics, calendar, to-do, and e-mail applets). (617-577-8500; http://www.kona.lotus.com)

But vendors such as Applix, which already sells Java-based business applications, continue to forge ahead with new versions. Corel, after rethinking its strategy, says it will release a new Java suite next year, and Lotus plans to release Java productivity applets in the fourth quarter of this year.

Corel originally announced plans for a Java version of its full-function Office suite of applications, but the company has since scrapped that approach. "The problem was that we would demonstrate our applications, and the response from users, even at pro-Java sites, was 'This is great, but can you add just this one feature?'," says Chris Biber, Corel's director of strategic alliances. "Before you know it, users were asking us to add more and more features. Adding all those would have resulted in a chubby—not a thin—client." Corel will satisfy demands for a fully functional, Java-enabled office suite with its Remagen technology (see the table above), while a new product line, currently code-named Alta, will combine elements of CorelCentral and the evolved Corel Office for Java.

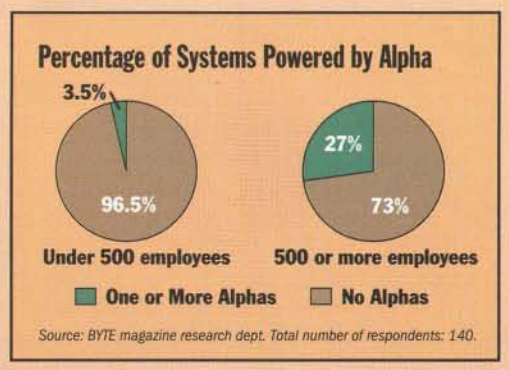
While Corel and Lotus work on their projects, Applix says it will continue to improve its existing Anyware Office and Enterprise Anyware (which consists of sales, service, and help-desk modules). "We've already released our first suite, so we know that you can use this kind of technology to create complex applications for the power-user community," says Barry Burke, vice president of product marketing at Applix.

However, as vendors go forward, they will have to master the art of broken field running as the Java platform evolves. The latest donnybrook between Microsoft and Sun, over which foundation class to support—Sun's JFC or Microsoft's AFC—in addition to questions over who should control the Java standard may only serve to impede Java's growth. **–D. A.**

Survey

Small Companies Snub Alpha

Most companies select x86-based hardware to run their Windows NT applications over Digital's Alpha CPU, especially companies that have less than 500 employees. According to a recent survey of companies that now run Windows NT, which was conducted by BYTE's research department, almost 97 percent of those smaller companies don't have any systems powered by Alpha CPUs.



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Circle 130 on Inquiry Card.

Datapro Report

Server Wars: Sun and Compaq Take Shots at Each Other

Sun Microsystems' recently announced Ultra Enterprise 450 Work Group server is a stiff competitor for Compaq's ProLiant servers. The Enterprise 450 levels the cost-of-ownership issue against Windows NT/Intel (Wintel) servers, offers better performance, supports PC-client environments, and offers the resiliency of Solaris and scalability across Sun's Enterprise server product line (which supports up to 64 processors in a symmetric multiprocessor/server configuration). Compaq's ProLiant 7000 (see article, next page) is strategically positioned against the 450, but Sun's 450 announcement is a bold strike against Wintel.

The Enterprise 450 is a robust midrange server. It supports up to four UltraSparc II processors, which use Sun's UPA system bus; it has a peak speed of 1.78 GBps. This compares with 540 MBps for Intel's Pentium Pro. A fast system bus lets multiple processors access memory faster, providing more efficient symmetrical multiprocessing.

The Enterprise 450's I/O architecture is based on the PCI bus: It has six PCI buses, including three 66-MHz PCI buses, resulting in a peak I/O bandwidth of just over 1 GBps. This is more than three times the I/O bandwidth of the Pentium Pro Intel servers, which support two 33-MHz PCI buses.

The Enterprise 450 is actually priced less than Compaq's ProLiant 6000 and 7000 servers (see the table below). And Sun has taken care of third-party application software costs, which were a huge differentiator between midrange Unix servers and Wintel servers. Sun has negotiated a new workgroup-server pricing level for one- to four-way Sun Enterprise servers that levels the pricing differentiation for applications such as Oracle and Sybase. Third-party applications for Sun's Enterprise 450 are priced the same as identical applications for Wintel servers.

Sun's Enterprise 450 server provides more performance than the fastest Intel servers currently available for Windows NT 4.0 (see the table). Compaq has yet to publish a TPC-C result for the ProLiant 7000 for NT, but it claims 10,547 tpm for the ProLiant 7000 with four 200-MHz Pentium Pros running SCO UnixWare. Its price/performance result ($71/tpm) was not as good as Sun's. Compaq is expected to publish a TPC-C result for the ProLiant 7000 running NT, which should have better price/performance—and maybe even better performance.

PC users can access their files transparently from any Sun server with Sun's Solaris for Intranets, which ships with every Sun Enterprise server. Solaris for Intranets is also available for $1290 for Solaris Intel platforms.

Sun's Enterprise 450 has 10 PCI slots, including 66-MHz, 64-bit-wide ones.

Introduced recently, SunLink, a module of Solaris for Intranets, supports file systems for Windows 3.11, 95, and NT; Mac; NetWare; and MS LAN Manager. Print-sharing and file-sharing services for these clients are supported by SunLink. PC users can access their Microsoft Office files from Sun's 450 without changing anything. SunLink is included with the Enterprise 450 server, but no additional client software is needed.

Sun has completely disguised Solaris from PC users, who can install the Enterprise 450 (or any Sun Enterprise Server) using any browser. Sun's WebStart is an easy one-button installation that has options for customized configurations. Installation is no harder than it is for Compaq's SmartStart.

The Enterprise 450 has many, but not all, of the Reliability, Availability, and Serviceability (RAS) features found in the Enterprise 3000, 4000, 5000, and 6000 servers. It comes standard with two (and an optional third) 560-W power supplies, which are hot-swappable. Sun's 450 also supports hot-pluggable disk drives, thermal sensing, and four levels of system diagnostics.

Sun's SyMON provides a complete set of on-line diagnostics. If a CPU or memory module fails, the 450 detects the failure automatically, takes the failed module off-line, and continues to process. But the system does not support on-line reconfiguration (as other Sun servers do), where a failed processor or memory module can be replaced, or a new module added, and the system can reconfigure itself without being taken down.

Short of supporting NT, Sun has done almost everything it can do to take on Wintel workgroup servers: It has eliminated price as a barrier and brings most of its enterprise capabilities to the workgroup server. The Enterprise 450 should gain market share against Sun's major Unix competition (HP and IBM), whose Unix midrange servers lag far behind. For mixed Unix and NT environments, Datapro recommends that customers evaluate both Sun and Compaq (and other Wintel platforms) for workgroup computing.

Peter Lowber *is a principal analyst for Datapro, a division of the Gartner Group. For more information on Datapro reports, call 609-764-0100; fax 609-764-2814; or see http://www.datapro.com.*

Sun Strike on NT

	Sun Enterprise 450	Compaq ProLiant 6000	Compaq ProLiant 7000
Processor/MHz	UltraSparc II/250 and 300	Pentium Pro/200	Pentium Pro/200
L2 cache	1 and 2 MB	512 KB and 1 MB	512 KB and 1 MB
TPC-C tpm results	11,560 (four 300-MHz CPUs, Solaris 2.6, Sybase 11.5)	9029 (four CPUs with 512-KB cache, UnixWare, Sybase)	10,547 (four CPUs with 1-MB cache, UnixWare, Sybase)
$/tpm	56.6	79	71
Entry street price (128 MB of memory, 4-GB disk)	$14,650 (250 MHz) $19,150 (300 MHz)	$15,196 (512-KB L2 cache with NT Server 4.0)	$23,016 (1-MB L2 cache with NT Server 4.0)

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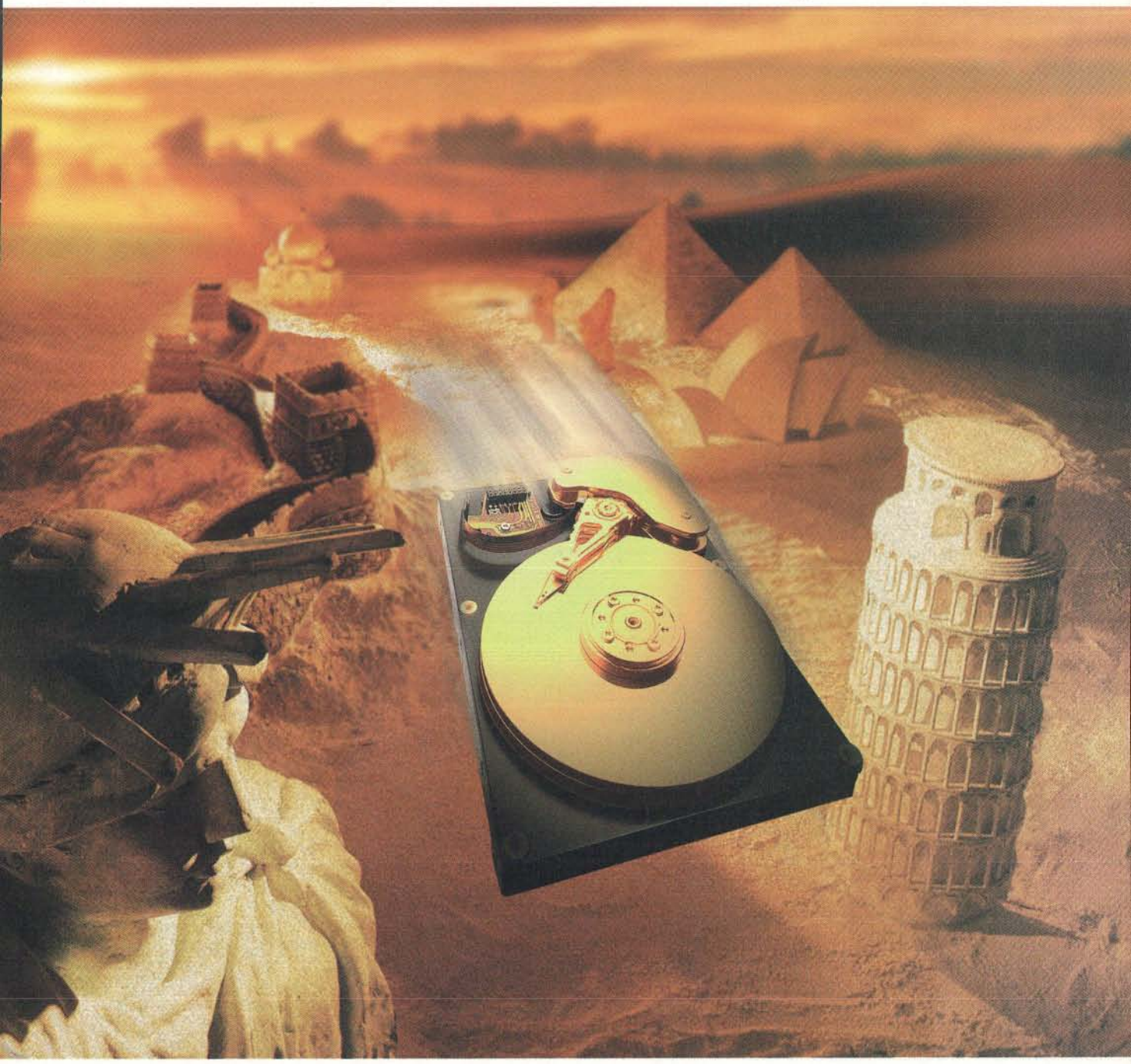

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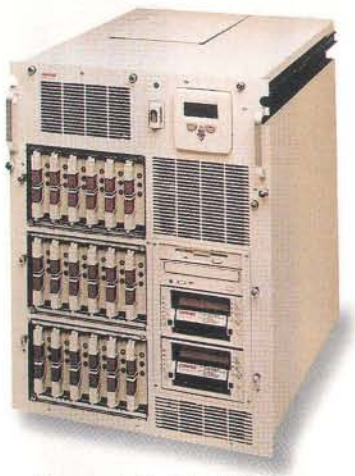
SAMSUNG ELECTRONICS

ProLiant 7000 Takes on Sun 450

With the excellent reputation Solaris has for supporting enterprise-class, mission-critical environments, and the scalability of Sun's Enterprise Server line, Sun's 450 is attractive for workgroup server and enterprise environments. But with its ProLiant (PL) 7000, Compaq has developed a server that's strategically positioned against Sun's 450.

The PL 7000 provides many of the same Reliability, Availability, and Serviceability (RAS) features as Sun's Enterprise 450 (see Datapro Report, previous page). In addition, the PL 7000 supports up to four of Intel's Pentium Pro 200-MHz, 1-MB, L2 cache processors.

But Compaq is positioning the PL 7000



Compaq's ProLiant 7000 is expandable to eight CPUs.

with the future capability to support up to eight Intel processors. As eight-way servers for NT become a reality with NT 5.0 and Deschutes, the next-generation Intel server processor, the pressure will be back on Sun. The 450 is only a four-way server; for more scalability, Sun users are forced into a much-higher price bracket. Also, Compaq is strategically positioning the PL 7000 as a standards-based server for hot-plug PCI and I_2O.

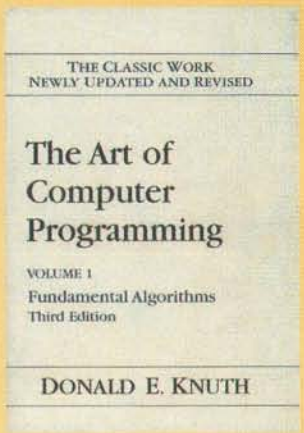
Now that Sun is supporting the PCI bus, Compaq is upping the ante. This is not an issue yet, but it may become one as these new standards materialize during 1998. **–P. L.**

Book Reviews

The Bible, Updated

Donald Knuth's magnum opus *The Art of Computer Programming* is, quite simply, the bible of classical computer science. "The Knuths" are still referred to and studied in an age when technology changes faster than processor clock speeds. Now, for the first time since 1972, Knuth is updating his lifework. Addison-Wesley has released the first volume, *Fundamental Algorithms*; the second (*Seminumerical Algorithms*) and third (*Sorting and Searching*) are due to arrive in November.

It is Knuth's philosophical approach that preserves his work so well. He does not prescribe to the latest trend in programming languages. Instead, he expounds the fundamental flow of programming algorithms, the essential architecture of data structures, and the basic mechanisms of stacks and queues, using, as he puts it, "English as my high-level language." This approach cannot fairly be dubbed "generic." Given the clarity and specificity of Knuth's models, these constructs can be directly applied to a broad range of languages, OSes, and hardware architectures.



Typically, Knuth first describes an algorithm or structure in general terms. He sets up the discussion with tables, flow diagrams, and other graphical aids. For instance, when opening the section on information structures, Knuth covers important terms and notations by describing a simple algorithm involving playing cards. The sample data structure includes fields for TAG, SUIT, RANK, NEXT, and TITLE–the fields required for the data record. He then displays the actual cards next to a computer representation of the data records. Next, a figure shows record structures along with arrows that depict how the records are linked. An algorithm for turning over a new card is presented step-by-step, accompanied in parentheses by relevant comments, as shown below.

```
A1. Set NEXT(NEWCARD) to TOP. (This puts the appropriate link
                                into the new card node.)
A2. Set TOP to NEWCARD. (This keeps TOP pointing to the top
                         of the pile.)
A3. Set TAG(TOP) to 0. (This marks the card as "face up.")
```

Finally, Knuth uses low-level assembly language for the routine, listing each command with comments. This meticulous, thorough methodology proceeds from a general description to a specific implementation, so you understand the flow logic, the data architecture, and the practical implications of the algorithm. The bulk of the first volume covers information structures, including stacks, queues, binary trees, and dynamic storage.

In his update, Knuth incorporates his own handwritten notes and adds hundreds of new exercises and solutions, focusing on subjects that have "converged" over the years. In some cases, Knuth concedes that a subject is evolving too rapidly to pin down. And in one notable passage, Knuth admits that his MIX system, a mythical computer that he uses to elucidate his models, is "now quite obsolete"–for example, MIX has no OS; it bootstraps from tape. He plans to replace MIX with a 64-bit RISC computer, the MMIX 2009, but he has delayed converting the programs in Volumes 1 through 3 until after next year (and the completion of Volumes 4 and 5).

This is no casual read. But it is *the* essential reference for the serious computer scientist and anyone who wants to understand computer structures and programmatic flows. If you want a deep understanding of buffer-allocation or garbage-collection routines, along with alternative approaches and efficiency analysis, consult your Knuths.

Stan Diehl *is a frequent contributor to BYTE and former director of BYTE reviews. You can reach him at sdiehl@nebs.com.*

The Art of Computer Programming, Volume 1: Fundamental Algorithms, Third Edition
by Donald Knuth; Addison-Wesley; 656 pages; 0-201-89683-4; $49.44

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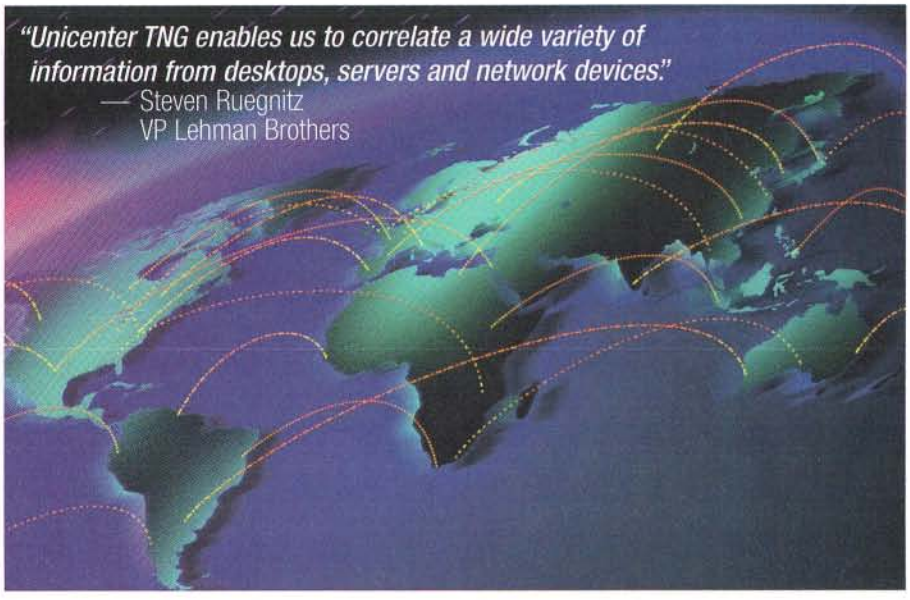

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Blasts from the Past

5 Years ago in BYTE

What goes around, comes around. Five years ago, the hot topic was penny-pinching PCs. Dell's Dimension 386SX/25 system offered an 80-MB hard drive, two floppy drives, Windows 3.1, and a mouse for just $1359. Inexpensive PCs made lots of news this summer, too—not only traditional Pentium-type PCs that sell for under $1000, but NetPCs and network PCs (and cost of ownership), too.

10 Years ago in BYTE

Bill Gates was drumming up support at users-group meetings for OS/2, but developers (and BYTE columnist Jerry Pournelle) complained that OS/2 didn't take advantage of the 386 and that it was a crippled OS on the 286. Compaq's 20-MHz Portable 386 weighed 20 pounds, had 1 MB of RAM, and 40 MB of hard drive space for a mere $7999.

15 Years ago in BYTE

Remember the movie *Tron*, about a programmer who finds himself trapped inside the electronic world of computers? Today its special effects seem tame, but at the time people were wowed. We wrote about how it was made and how *Tron* presaged a new era in computer-generated imagery.

20 Years ago in BYTE

Steve Ciarcia's well-known Circuit Cellar column, one that attracted a loyal following over the years, debuted. And Apple co-founder Steve Wozniak wrote an article about how to extend the 6502 processor using software.

INTERVIEW

10 Steps to Better Usability

Jakob Nielsen, Sun Microsystems Distinguished Engineer, discusses the hows and whys of product usability.

BYTE: *You've studied usability and user-interface design issues since 1983. Is the number of people who design products with which others interact increasing?*

Nielsen: Oh, yes, more people are already designing their own user interfaces, in the sense that a Web page is a user interface. The scope of user-interface design has expanded dramatically because of the Web. It used to be a small set of professionals doing it. But now, it's essentially everybody, because everybody seems to be designing a Web site.

My analogy is that designing a Web page is quite similar to designing a dialog box. In either situation, you're designing a set of options for users. These options include what users can click on, what they can do, and what the stream of their attention is when looking over the layout.

Designing a Web site is similar to designing an application. You have to worry about not just those detailed issues, but also about the navigational flow. How users move between all those different options is one example of what comes into site design as opposed to page design.

We now have millions of people doing this, whereas, a few years ago, we had a few thousand people doing this. Many of the issues and problems that we see on the Web today, such as inconsistency, are the same ones we've had with other systems, such as mainframes, for a long time.

You can get more on this topic from http://www.useit.com/papers/heuristic.

Nielsen's Top 10 List

PROVIDE STATUS FEEDBACK. The system should tell users what's going on. "This is particularly true for the Web, which is not yet robust and reliable."

MATCH BETWEEN SYSTEM AND REAL WORLD. The system should communicate in words, phrases, and concepts that are familiar to the user.

GIVE USERS CONTROL AND FREEDOM. "Don't trap people in a state where they cannot escape. Always have a cancel button available."

BE CONSISTENT. "If a button for your home page is always in the same location, users don't have to figure out where it is."

PREVENT ERRORS. This may sound obvious, but if something is likely to lead to an error, make it difficult to do and ask confirmation questions such as, "Do you really want to do this?" But don't overdo the confirmation, or the user may get impatient and click "YES" to everything.

MAKE OBJECTS, ACTIONS, AND OPTIONS INTUITIVE. "Recall, where you have to remember what something does, is much more difficult than recognition, where you immediately know what something does."

PROVIDE FLEXIBILITY. "Give experienced users shortcuts and give novice users Wizards. There should be more than one way to accomplish a task."

PRACTICE AESTHETIC AND MINIMALIST DESIGN. "Every piece of information on the screen competes with all the other information there. If something isn't necessary, remove it."

HELP USERS RECOGNIZE, DIAGNOSE, AND RECOVER FROM ERRORS. "In an error-message situation, the user is motivated to overcome a problem. Errors are a primary opportunity to teach users through informative error messages."

PROVIDE ON-LINE HELP that provides quick answers to specific questions.

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Don't Blink

Your eyes might be the best way to control your PC screen.
Page 32IS 3

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Broadband Choices

ISDN or ADSL? The question just won't go away. *Page 32IS 7*

Bug Hunters

New testing tools help software developers control bugs and costs. *Page 32IS 17*

Greener Design

Software helps manufacturers build environment-friendly products. *Page 32IS 23*

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Don't Blink

Forget Windows, icons, and your mouse. Your eyes may be the ultimate computer commander.

Envision a PC that lets you trace a series of hyperlinked documents as you glance at the keywords or activate an incoming e-mail message by just looking at the subject line. Researchers at the Heinrich-Hertz research institute (HHI) in Berlin recently demonstrated a gaze-controlled 3-D user interface. It works without inputting traditional explicit commands. "Our current prototype reads users' gazes and reacts before they can utter a command," says Siegmund Pastoor, a project leader at HHI.

Called Blick (the German word for gaze), the system includes an autostereoscopic display that represents objects in 3-D without the user wearing either a head-mounted display or shutter glasses. Built-into-the-monitor head-tracking and eye-tracking cameras capture a user's gaze.

"The advantage of our system is that users do not need to look at a fixed point on the screen or hold their head in a particular position," says Pastoor. Blick projects the stereoscopic right- and left-eye views into the user's visual field.

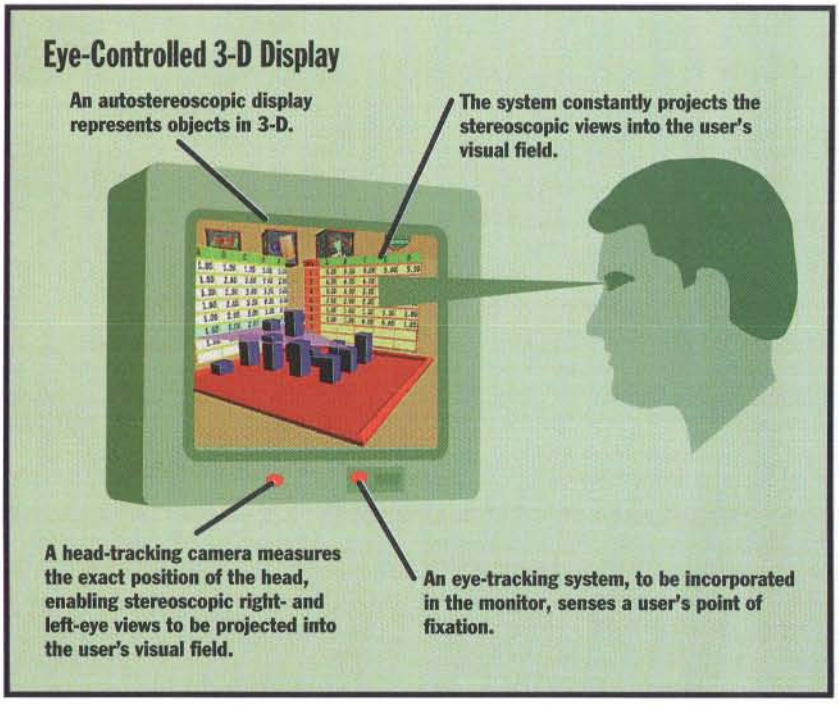
Blick's autostereoscopic, free-viewing 3-D display uses direction multiplexing, a display technique that makes different perspective views visible only from specific positions. For each position, the system calculates on the fly both stereoscopic views and projects them together to create the illusion of a 3-D space. Images seem to jump out at you.

To avoid time lags between the head-tracking camera's image capturing and the stereoscopic visualization on the monitor (a typical delay of about 120 milliseconds), the system runs an algorithm to predict the viewer's head position. Thus, the graphics subsystem often works with anticipated head positions.

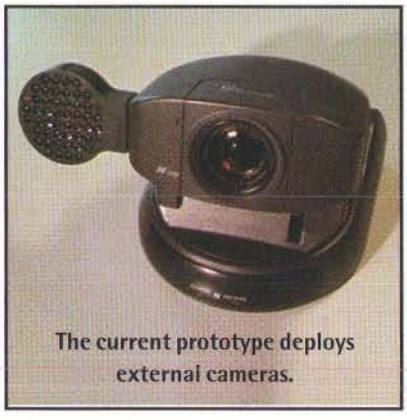
Additionally, an eye-tracking system constantly senses a user's point of fixation (via a cornea-reflex method). The system then simulates the limited depth of focus of the human visual system and makes currently fixated objects on the screen stand out against the environment. Thus, the user can interact with 3-D objects by just looking at them. If you focus on an object for more than 0.1 second, the object may change its shape or pop up new objects. Of course, the system takes time to get used to.

HHI researchers also developed a visual OS (VOS) that allows you to paste together objects, configure applications, and even "visually" program applications in 3-D space, controlled by your gaze. VOS runs on a Silicon Graphics Onyx machine and also allows for live videoconferencing in a virtual 3-D space.

–Rainer Mauth



The next generation of user interfaces may be in 3-D and controlled by your gaze.



The current prototype deploys external cameras.

Search the Net in Multiple Languages

Information retrieval on the Internet can be a laborious task, not just because search engines often give you links that are completely out of context, but also because you may stumble on sites that are in a language you don't understand. The only way around this hassle is a multilingual search engine that automatically translates information into a language that you understand. Lernout&Hauspie, a leading speech and language technology developer, is planning to offer this service in mid-1998.

L&H acquired several translation companies, including Mendez Translations (Brussels, Belgium), Translingua (Bonn, Germany), and Lexitrans (Madrid, Spain), last year. L&H says it will be investing $35 million in the development of Internet-based translation services. "Internet-based services will employ both our speech technologies and our newly acquired translation capabilities," says Bob Kutnick, L&H's chief technology officer.

The L&H on-line translation services will include multilingual text retrieval based on machine translation, and automated submission and receipt of human translations via e-mail. The L&H search engine will, for example, translate a German-language search request into English, create an abstract of the retrieved documents, and translate the result back into German. According to Kutnick, the engine will also rank translated documents and build content clusters that make it easier for you to narrow down your interests. If you want an exact translation of your findings, you will be able to submit documents via e-mail.

The company plans to offer several levels of services (e.g., basic machine translation for a flat monthly fee, unlimited domain-specific machine translation for a higher fee, and combined machine and human translation on a per-page basis). At press time, L&H had not set fees for these services. First supported language pairs will be English/Spanish and English/German (bidirectional). Bidirectional translations from English to French, Italian, Mandarin Chinese, Korean, and Japanese will follow, though L&H declined to say when they would be available.

The services will initially be targeted at certain business domains such as law and medicine. A prototype service will be launched by the end of the year.

–Rainer Mauth

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New Driver Could Lead to Brighter, Cheaper LCDs

Prime View International Co., Ltd., of Taiwan has developed an LCD driving method that can crank sharp and crisp color images out of a thin-film transistor (TFT) LCD. Called the Integrated Driving Technology, this new driving method will give TFT LCDs higher resolution than other active-matrix LCDs, the company claims.

"We are the first in the world to offer such an advanced technology," says Dyi-Chung Hu, senior director of R&D and the LCM manufacturing division at Prime View. The new driving technology has received patents in the U.S., Australia, and Taiwan, and is patent-pending in Japan and the EC.

The Integrated Driving Technology will lower the cost of the LCDs by drastically reducing the number of driver ICs. Hu explains that in conventional active-matrix TFT LCDs, higher resolution has to be addressed by more individual pixels, resulting in a greater number of driver ICs.

For a Japan-made 5.4-inch TFT LCD, it requires six ICs—two 120-pixel I/O scan-driver ICs and four 240-pixel I/O data-driver ICs—to drive pixels to create a full-color display. However, using Prime View's Integrated Driving Technology circuitry design, you can achieve a full-color, video-rate display with only one 240-pixel I/O data-driver IC.

Prime View's latest 1.8-inch TFT LCD module using the technology has a high resolution of 234 by 480 pixels, compared to standard 220- by 279-pixel resolution supported by the existing 1.8-inch models. It will let digital camera users obtain all the detailed images for back-panel review and replay.

The LCD module also applies an advanced chip on glass (COG) mainstream technology, which directly mounts the driver LSI onto the glass of the LCD and thus produces a thin LCD panel. Compared with the currently used tape-automated-bonding (TAB) technology, the COG process cost is lower and the process yield rate and reliability are higher.

"We are seeing more and more consumer and small industrial products incorporate specialized LCD panels. Almost all of the next generation of digital cameras will include LCDs," Hu says.

–Stella Kao

Better 3-D Sound Coming to PCs

Audio chip manufacturers such as Taiwan's C-Media and Japan's Yamaha earlier this year licensed Central Research Laboratories' new Sensaura Digital Ear 3-D audio technology. Yamaha says it selected CRL's algorithms because, for the first time, they provide spatially accurate sound perception using only two stereo speakers.

The Sensaura 3-D audio core digitally emulates human hearing. Music takes on a "bigger room sound," including the spatially accurate acoustic perception of the recorded environment. The Sensaura-compatible chips manufactured by Yamaha and C-Media are meant for PC-related multimedia applications such as computer games and virtual-reality applications. They can make any monophonic or multichannel source sound like a spherical 3-D sound field by virtually positioning sound sources all around the listener, including above, below, and behind. Secondary processing provides sound effects, such as reverberation and Doppler shifting. The system also includes cross-talk cancellation that is critical for loudspeaker playback.

The chips will be compatible with Microsoft's Direct3DSound and the Virtual Dolby standards. Expect to see the first PCs including the new 3-D audio technology early next year from Taiwanese PC manufacturers such as Mitac.

–Rainer Mauth

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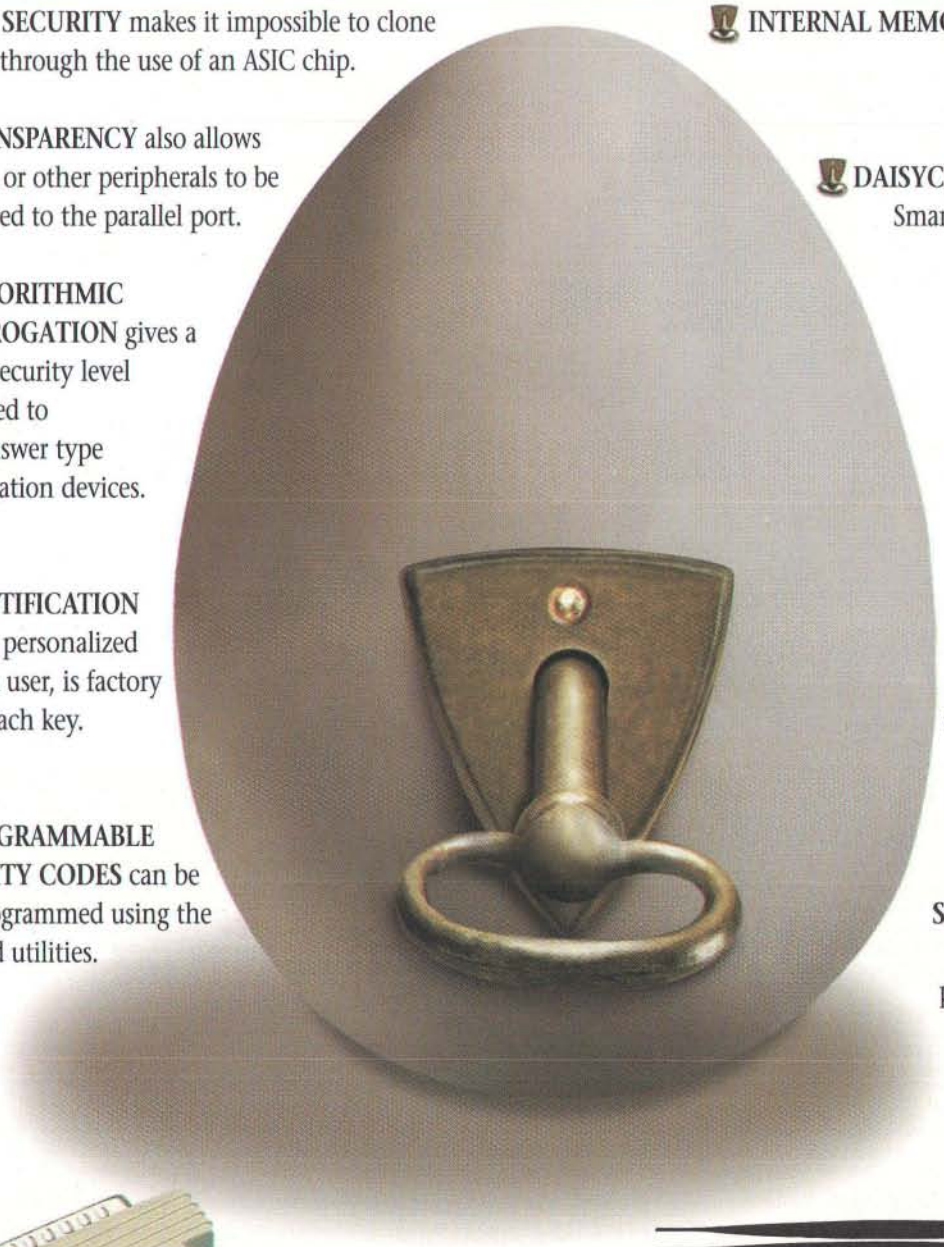

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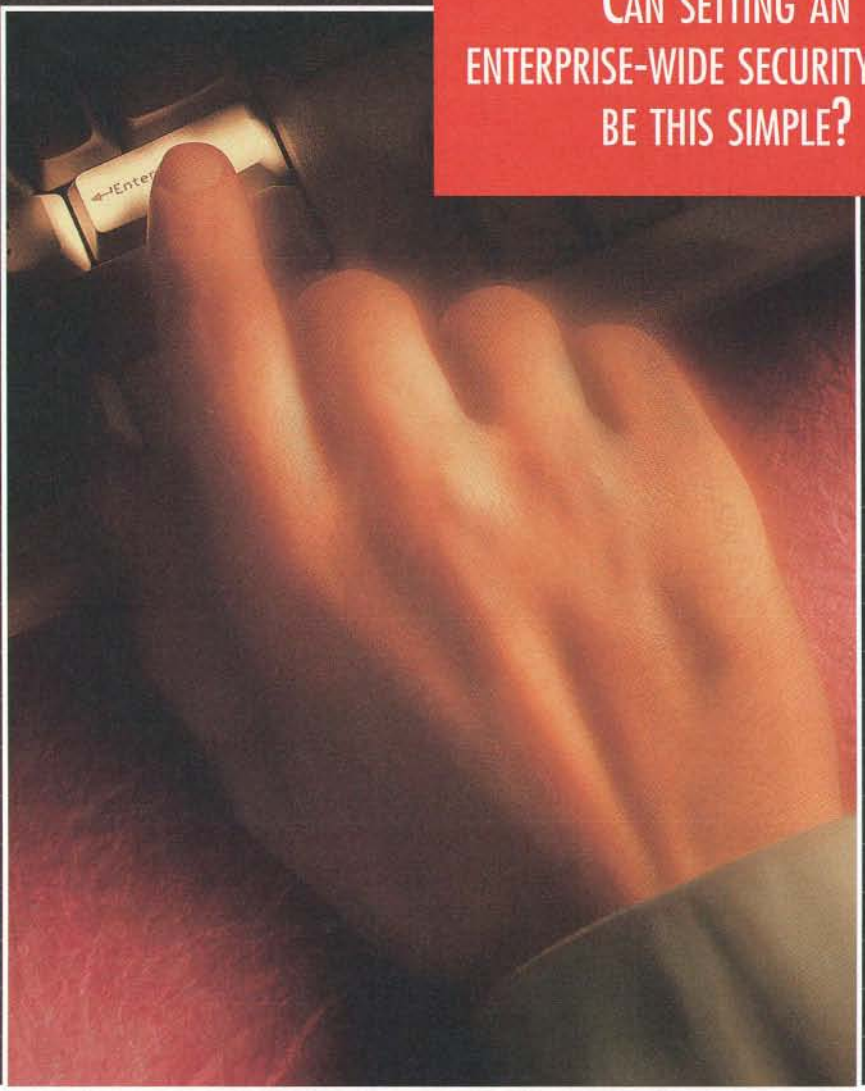

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Broadband Choices

The ISDN-versus-ADSL question just won't go away, at least in Asia and Europe in 1998.

By Stella Kao

The battle over who gets to bring broadband to the home is heating up. While ISDN seemed to be the answer a few months ago, other—possibly more practical—solutions are beginning to emerge: 56-Kbps/112-Kbps modems, cable modems, and Asymmetric Digital Subscriber Lines (ADSLs).

To date, most Internet service providers (ISPs) still operate at 33.6 Kbps, with only a few of them offering 56-Kbps speed. Routing pathways often limit throughput even further. These bottlenecks are worse during times of heavy traffic. Throughput can fall well below what current analog modems can handle. Thus, the demand for speedy broadband technologies is on the rise.

ISDN's Wide Availability

ISDN is the most widely available technology of the high-bandwidth options. Most competing high-speed offerings are currently in various stages of research, testing, and deployment. None of them are as mature or as widespread as ISDN.

Even in the U.S., where ISDN is seen as a not-so-attractive technology, an increasing number of ISPs are now capable of handling ISDN. Once it's installed properly on the user end, this high-speed technology connects reliably at speeds of up to 128 Kbps and transfers data at speeds of up to 300 Kbps with compression.

There are two types of ISDN: Primary Rate Interface (PRI) and Basic Rate Interface (BRI). PRI ISDN is generally found in telephone switches, computer telephony, voice processing, and dial-up Internet access. Residential installations and small businesses chiefly use BRI ISDN. A BRI ISDN link provides two B channels for data and voice transmission, and a D channel for signaling functions, such as call setup. You can use either or both B channels for LAN-to-LAN access, Internet access, videoconferencing, or other applications that demand higher bandwidth than analog modems can provide.

To achieve an aggregate 128-Kbps throughput, all ISDN modems now support the multilink PPP channel-bonding technology, which lets two connecting units negotiate and combine two or multiple channels to serve as one larger pipe with expanded bandwidth. In addition, multilink PPP ensures interoperability with all carrier equipment. What's more, by incorporating a new technology called Always On/Dynamic ISDN (AO/DI), the D channel will soon be available to carry e-mail, news headlines, or other data—without having to dial up an ISP or corporate network.

Therefore, ISDN users could speak on one voice channel, send files into a corporate office on another, and get low-bandwidth data such as e-mail on a third. And because the D channel is always live between the ISDN subscriber and the phone company's central office, users save the cost of dialing up every time they want to get low-bandwidth data.

A Dead Technology?

Contrary to many phone companies' expectations, ISDN services did not take off as planned, especially in the U.S. Users complained that it was difficult to install, that the phone companies took forever to set up the lines, that technical support was inefficient, and that it was too expensive.

Also, ISDN's 64- or even 128-Kbps rate hardly spurred the interest of the business community, which handles many bandwidth-hungry communications applications such as shared CD-ROM access, shared live video catalogs, interactive movies, and real-time, downloadable videos and music.

"If such obstacles in getting ISDN service cannot be removed,

ILLUSTRATION: MATSU © 1997

users will turn to emerging new high-bandwidth technologies," says Thomas Huang, president of VersaNet Communications, an affiliate of Taiwan modem maker CIS Technology.

In fact, a handful of ISDN vendors have already predicted that ISDN may eventually be replaced by faster technologies such as ADSL or cable modems. However, "these data-only solutions are not likely to replace ISDN, but to coexist," according to Felix Jeng, R&D manager at Alpha Telecom, a professional customer premises equipment (CPE) manufacturer.

Jeng points out that cable-modem services don't cover switched voice traffic. Cable-modem service is based on a shared-network topology, which means that the amount of bandwidth that's available to a customer depends on how high the traffic volumes are at any given time. In addition, he says that the shared networks operate at a speed as fast as 10 Mbps. This should give customers at least as much bandwidth as BRI ISDN under normal traffic loads.

"At least for the next two years, cable modems and ADSL devices will not pose any threats to ISDN," says Jim Hsieh, ISDN project leader for the communications product business division at CIS. ISDN is the best solution because users are able to manage phone calls, e-mail, and videoconferencing with one technology, Hsieh adds.

Cost Is a Big Factor

In spite of its slow takeoff in the U.S., ISDN has long been a standard for high-speed remote access in regions where the infrastructure is complete and the service is easy to come by. Europe and Japan have seen the greatest success in terms of ISDN proliferation. In Japan, it has the strong backing of the government. There will be nearly 1 million ISDN lines installed there by the end of the year.

This is why most Taiwanese ISDN product makers target Japan as their largest sales outlet. However, because Japan's NTT and NEC corporations dominate more than 80 percent of their home market, there is little room for market expansion in Japan.

Many modem and networking-product manufacturers in Taiwan are applying their mass-production strengths to volume ISDN service providers who need terminal adapters (TAs) and infrastructure equipment such as routers, bridges, and switches.

Most ISDN TAs that Taiwanese companies make are 16-bit ISA cards with Windows 95 Plug and Play support. These internal cards sport common features as they all use solutions provided by chip makers. Cutthroat competition among ISDN vendors has largely brought card prices down, resulting in decreasing profit margins.

Lately, vendors in Taiwan are moving more upscale by adding external ISDN TAs to their product lineups. While they earmark internal cards for the European market, stand-alone models are in large demand in Japan.

Finding ways to make ISDN TAs more suitable for use with portable computers, active, self-powered adapter cards that have their own processors, memory, and drivers are currently under development. E-tech will soon launch an active-type ISDN adapter that features a 32-bit CPU, at least 256 KB of static RAM (SRAM), and 8 KB of dual-port RAM for ISDN protocols and driver software. This will allow it to operate without host PC resources.

Full support for ISDN APIs such as WinISDN, Winsock with PPP, multilink PPP, Common API (CAPI) 2.0, and Telephony API (TAPI) is important to ensure a TA's operability. It lets ISDN TAs run most existing communications software and all commercially available applications.

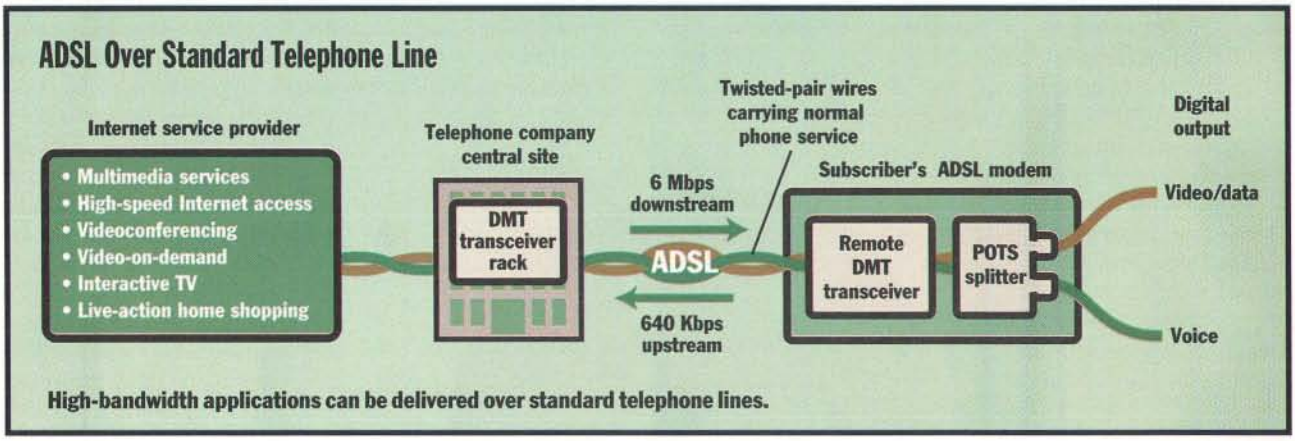
Standards Support

European users, especially those in Germany, require the use of CAPI 2.0, because it eliminates the need for COM-port emulation. Auto-detection for the 1TR6, 1TR7, 1TR12, E-DDS1, and NT-1 protocols, as well as the Network Driver Interface Specification (NDIS) interface for raw-HDLC (high-level data-link control), Cisco-HDLC, PPP, and MLPPP supports, are included in most Taiwanese products.

Additionally, these units conform to the ISDN-1, 5ESS, DMS-100, European Telecommunications Standards Institute (ETSI), and INS Net 64 standards for ISDN communications. Some of these models also come with bundled applications, such as Internet, videotext, file transfer, fax, voice, mail, and terminal-emulation software.

For the high-end corporate segment, Taiwanese manufacturers are making more routers that enable multiple users on a LAN to access the Internet at high speeds. ISDN routers, like other routers, let users build anything from complex switched-circuit networks to simple peer-to-peer dial-in connections. Users can also fine-tune their line usage, which can reduce ISDN fees.

Many ISDN routers are equipped with some combination of a standard Ethernet port, multiple plain old telephone service (POTS) ports, and a built-in fax modem. Some of the routers even have a built-in



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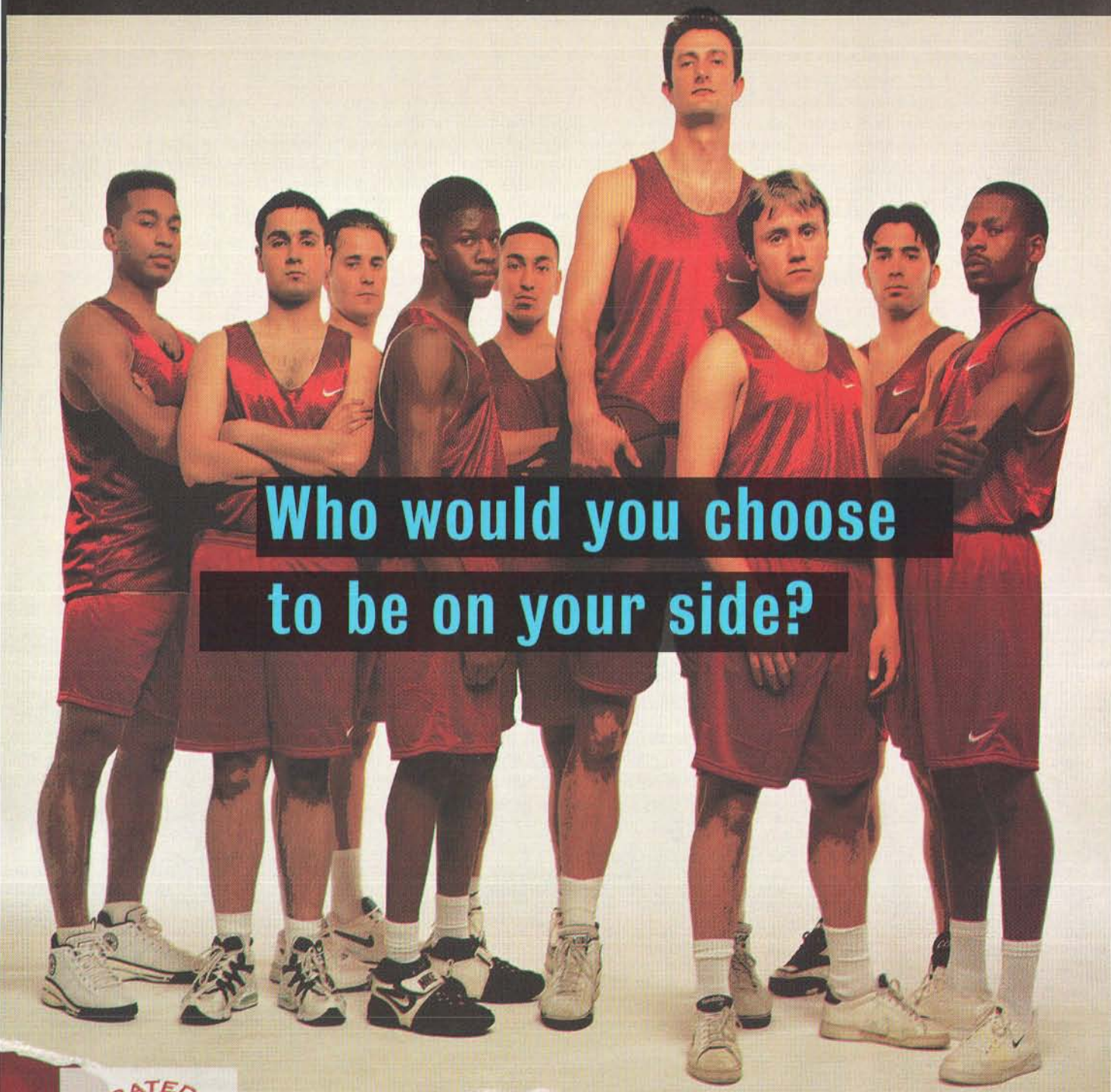

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Ethernet hub. This bundling obviates the need for extra analog lines for the user's office and additional equipment. The Prestige 2864I, from ZyXel Communications, for instance, has an option of a five-port external Ethernet hub.

The standard for compression in ISDN routers is Stac LZS, which offers up to 4-to-1 and 5-to-1 data-compression ratios. However, though many router vendors implement Stac LZS and most implementations work together, some vendors support Microsoft's Stac compression, which may not work with other Stac-based compression. Many vendors support both types, but a few support only one.

Another unique feature that's supported by ISDN routers is IP-address sharing. With this feature, each remote workstation has its own local IP addresses, but all outbound packets from the remote workstations share a single IP address, which is attached at the router. Inbound packets destined for those machines are sorted by the router and readdressed to those specific remote workstations. Because dial-in ISPs typically charge by the IP address, this can save on operating costs and effort.

At the CeBIT show in Hannover, Germany, this year, ZyXel demonstrated its Prestige 100, which lets up to four users access the Internet at the same time, supporting IP routing. Another model, the Prestige 128, supports both IP and IPX routing, as well as bridging. A single-user account feature lets multiple users on a corporate LAN access the Internet simultaneously using a single IP address from an ISP.

ADSL on the Rise

ADSL links designed to give high-speed, inexpensive remote access to corporate LANs and the Internet over standard phone lines are the next big thing on the high-bandwidth horizon. The performance benefits are clear: The technology supports typical downstream rates of 1.5 to 8 Mbps and upstream links as fast as 640 Kbps. That makes it potentially more than 10 times speedier than ISDN without the requirement to install an expensive new medium.

But while a new infrastructure is not required, high equipment cost is keeping ADSL from significant growth in the consumer market for the time being. CIS's Hsieh speculates that wide-scale ADSL

Alternatives to ISDN and ADSL

The next several months will bring increasingly widespread deployment of a variety of high-speed broadband technologies, such as cable modem and xDSL, to areas that have access to ISDN or plan to use Asymmetric Digital Subscriber Line (ADSL).

112-KBPS MODEM

An analog modem designed for high-speed Internet and remote access over two analog telephone lines. Based on the synchronous integration of two 56-Kbps modems, a 112-Kbps dual-line modem communicates over two standard analog telephone lines, providing aggregated, uncompressed download speeds of up to 112 Kbps—nearly 3.5 times faster than the current ITU V.34 standard. Using the combined bandwidth of two telephone lines, though, the technology allows you to drop one line as needed for voice calls or faxes. Proposed and promoted by Texas Instruments and U.S. Robotics, the 112-Kbps analog modems that a number of Taiwan companies make should be in stores in the U.S. this quarter.

CABLE MODEM

Modems designed to provide high-speed services via cable networks. Cable modems are internal devices that connect PCs to cable networks. Many solutions are being developed, with speeds ranging from 64 Kbps to 30 Mbps. Taiwan's CIS Technology is working with Toshiba of Japan to develop a second-generation cable modem. The modem, featuring a downstream speed of 8 Mbps, will be available in the first half of 1998 from Toshiba.

ASYNCHRONOUS TRANSFER MODE (ATM)

A high-bandwidth switching and multiplexing technology based on small, fixed-length cells that allocates physical channels for specific connections. Highly scalable, ATM provides an ideal upgrade path for supporting higher-bandwidth applications and enables the simultaneous transfer of voice, data, and video traffic at very high speeds, and supports both LANs and WANs.

CNet Technology, a networking hardware vendor in Taiwan, has unveiled a new ATM module that you can use with the company's Ethernet switches. The module includes 15 ports and costs less than $1000 per port.

DIGITAL SUBSCRIBER LINE (XDSL)

A collective term for DSL transceivers that provide voice, data, and video services at megabit rates over standard twisted-pair wires. The technology includes ADSL, HDSL, SDSL, VDSL, RADSL, and more.

These are interim technologies that were developed to get around the local-access bottleneck using the installed base of copper wiring from phone and cable companies.

HIGH-BIT-RATE DIGITAL SUBSCRIBER LINE (HDSL)

A technology offering full-duplex E1/T1 access over two copper-wire pairs, without repeaters. HDSL specifications created by Bellcore use 2B1Q modulation techniques. The technology is frequently used to replace repeated T1 service over distances as long as 12,000 feet. Unlike ADSL, HDSL provides users with 1.5 to 6.1 Mbps in both directions instead of just downstream.

SYMMETRIC DIGITAL SUBSCRIBER LINE (SDSL)

Also known as single-line digital subscriber line, SDSL offers E1/T1 transmission speeds in upstream and downstream directions over a single copper-wire pair. SDSL is full-duplex, so it provides speeds of up to 1.5 Mbps both upstream and downstream.

The technology may be the preferred method for doing sophisticated real-time functions, such as conducting audio, data, and video communications, or remotely connecting to a corporate LAN.

VERY HIGH-BIT-RATE DIGITAL SUBSCRIBER LINE (VDSL)

An impending upgrade to ADSL, VDSL combines ADSL technology with ATM to give users speedy communications and network access over a twisted-pair copper wire at speeds of up to 60 Mbps downstream and 2.3 Mbps upstream over distances of up to 300 meters.

Though VDSL promises an ultrahigh downstream bandwidth over copper wire, some developers question the viability of a near-term market for VDSL, because it requires that a fiber-to-the-curb switched digital-video infrastructure be in place.

RATE-ADAPTIVE DIGITAL SUBSCRIBER LINE (RADSL)

A rival technology of ADSL, RADSL can boost speeds to up to 8.2 Mbps downstream and 1 Mbps upstream with discrete multitone (DMT) capability. Because its transmission speed is rate-adaptive, based on the length and signal quality of an existing telephone line, RADSL is not optimized for only one loop, but dynamically optimizes to each loop for the greatest throughput available.

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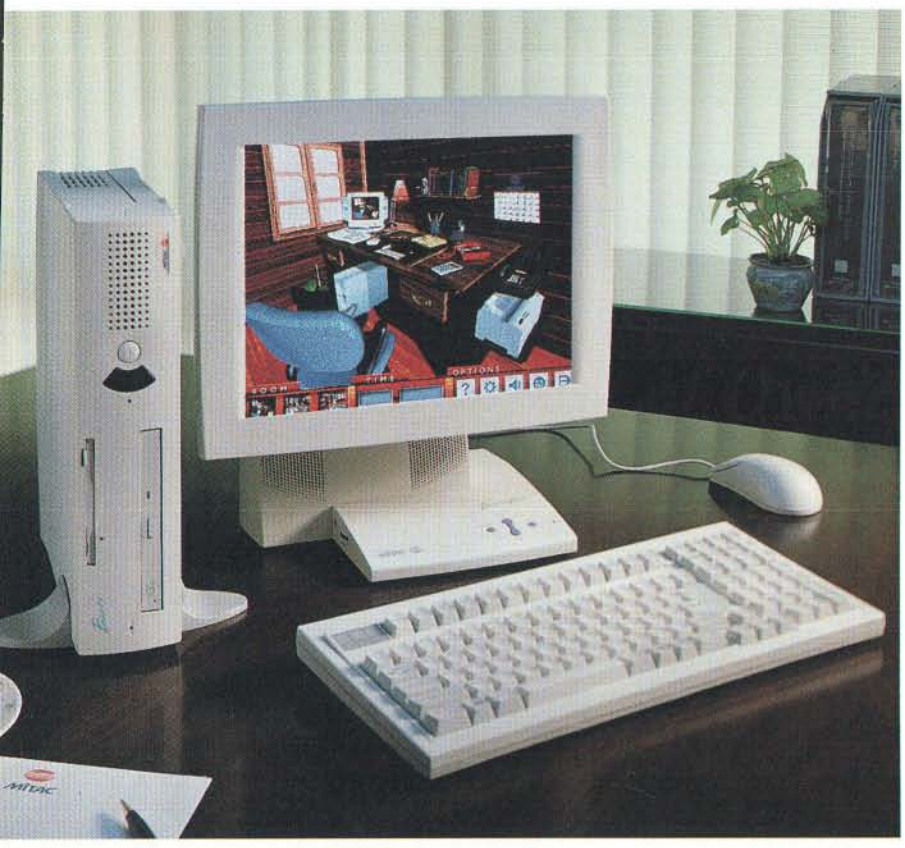

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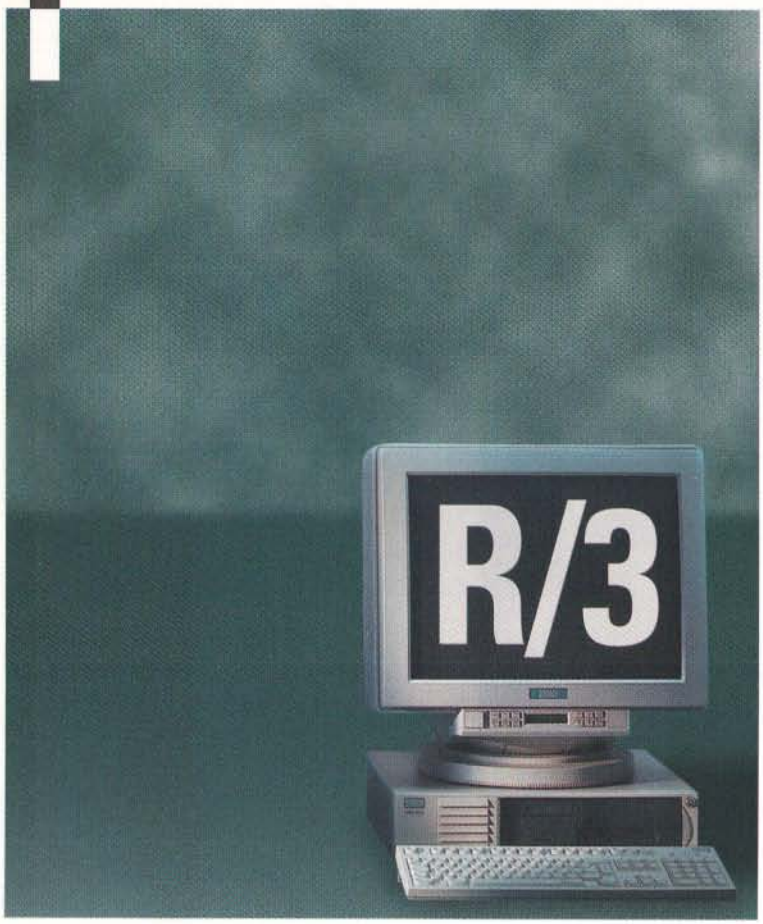

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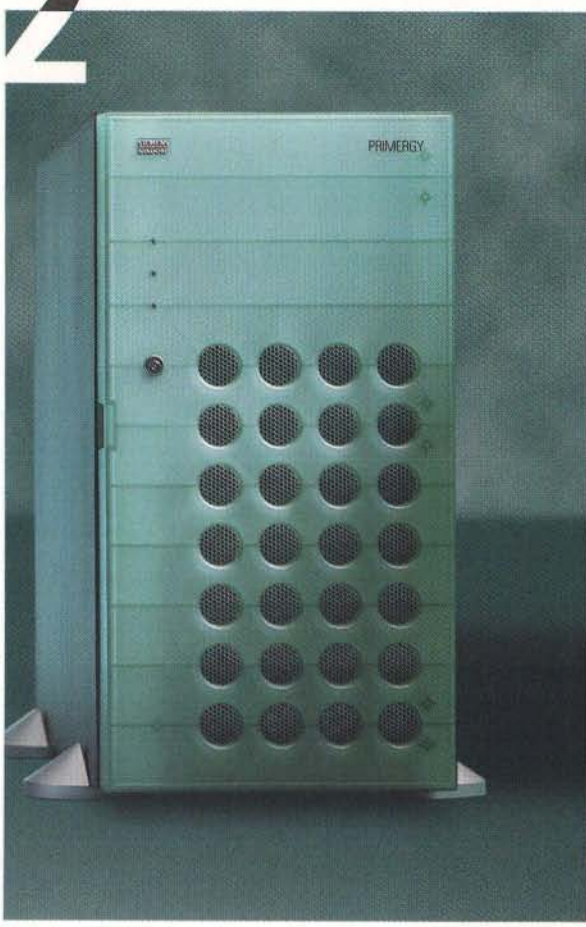

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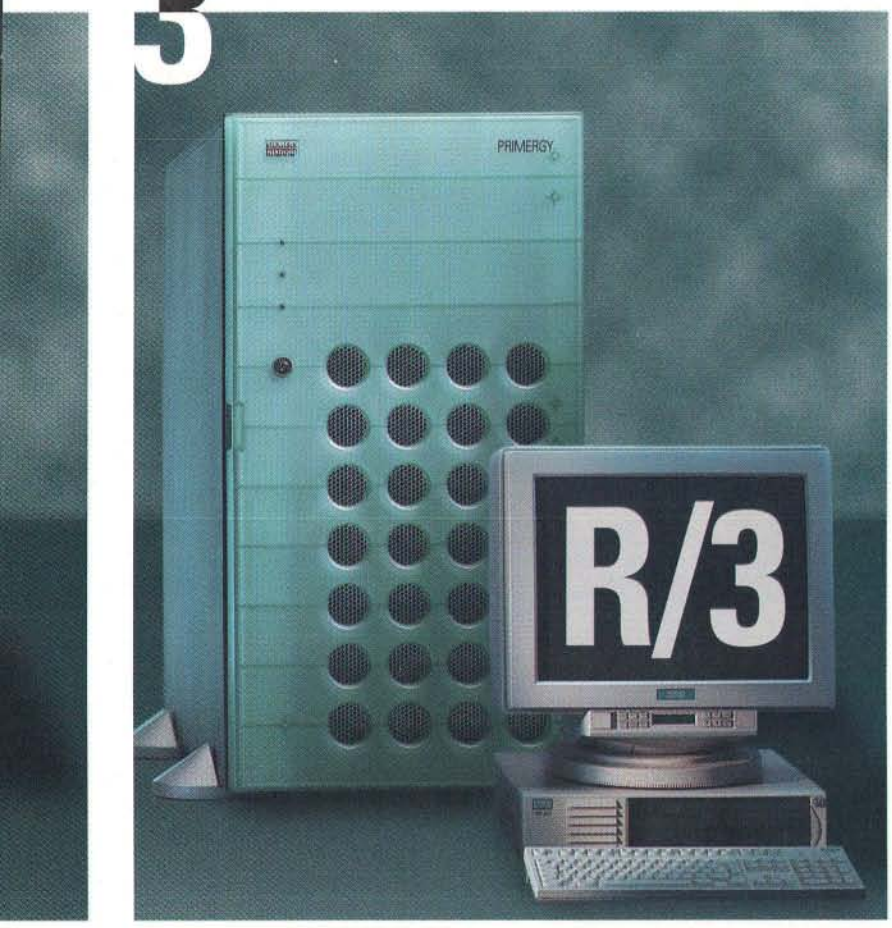

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deployment will not begin until 1999. All major telecom operators are doing trials in some areas.

In the meantime, some Taiwan companies are offering high-bit-rate digital subscriber line (HDSL) systems. Providing the same fast data throughput in a symmetric and full-duplex format, HDSL is now being considered as a viable data-access option for the mass market. Alpha's HDSL systems have been marketed and accepted in Japan.

Supports Three Channels

The ADSL technology supports three channels: downstream (simplex), upstream plus control (full-duplex), and POTS. As always, POTS occupies the lowest end of the bottom 4 kHz and is split off from the digital data by a passive low-pass filter, ensuring uninterrupted voice service even if the ADSL connection fails. Both the downstream and full-duplex channels can carry more than one bearer channel. Moreover, the digital portion of the connection never reaches the service provider's switching system, thereby offsetting network overload on the central switch.

In Taiwan, CCL/ITRI is a government-sponsored R&D organization. Chen Yun, manager of its transmission system department, says ADSL's channel-splitting capability makes the technology appealing to phone companies in the U.S. and elsewhere in the hope that they will be able to fend off competition from high-bandwidth data services offered by cable modems.

To take advantage of the technology, you need a special ADSL modem, and telecommunications operators must install special switches and equipment to provide service. Because most of the necessary switch upgrades are not in place, it will take some time to bring ADSL within reach of everyone.

Foreseeing a rosy future for ADSL as the most widespread high-bandwidth solution for connecting home computers to the Internet, modem manufacturers are revving up product development for the new ADSL technology.

CCL/ITRI heads an ADSL alliance with more than 10 modem and telecom companies, including Askey, DBTEL, GVC, Hitron, Tainet, Taiwan Telecom, Tecom, UFOC, U-King, and ZyXel. The first product produced by the alliance is a remote-site product: ADSL Remote Bridge and

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POTS splitter. The interface between each site is connected by an HDLC/ADSL interface. The service between each site uses a 10Base-T Ethernet interface. The frame-based media access control (MAC) encapsulation is implemented for ADSL router-based network access.

DMT or CAP?

For now, CCL/ITRI has yet to choose between two types of ADSL: discrete multitone (DMT) or carrierless amplitude and phase modulation (CAP). Both are designed to modulate bits that are sent though the line.

According to Chen, DMT is expected to become the industry standard in the future. The technology brings transmission speeds closer to the theoretical limits allowed by ADSL, because it is more robust against difficult line conditions and impulse noise. Another major benefit offered by DMT is support for interoperability between equipment from different vendors.

Another advantage of DMT is that line coding divides available transmission bandwidth into 256 independent subchannels. Interference to the signal in one frequency range does not have as great an impact as it would with the unified channel structure of CAP.

CCL/ITRI is currently caught between the two standards. While DMT offers more performance benefits, CAP is more widely used than DMT. Besides, CCL/ITRI officials worry that the price for DMT's chip set will remain too expensive and difficult to implement without the pressure of competition from CAP technology.

Reduced Cost

Recent developments that are aimed at reducing the cost of the ADSL technology are mainly directed toward increasing highly integrated, low-cost, high-performance chip sets. Leading suppliers for this market are Motorola, SGS-Thomson, Alcatel, Texas Instruments, and Analog Devices.

Originally, CCL/ITRI's ADSL alliance agreed to use Motorola's single-chip CopperGold ADSL transceiver, which guarantees the highest board reliability, according to Chen. CCL/ITRI is also Motorola's alpha-site test-bed for the solution. Nevertheless, Motorola is finding it difficult to increase its yield, according to sources in the alliance, making the alliance turn to alternative solutions from Alcatel or SGS-Thomson.

IC vendors from Taiwan such as Winbond Electronics and Macronix International have also announced development projects for ADSL chip sets. The move will help hardware makers to substantially reduce their costs.

Furthermore, CCL/ITRI plans to develop ATM-based (asynchronous transfer mode) ADSL technology in hopes that the technology will be competitive with cable modems without requiring telephone companies to overhaul vast portions of their existing phone network.

In 1998, the ADSL alliance will introduce the HLA system, which includes remote- and central-site products, ADSL Remote Bridge and POTS splitter and DSL Access Mux (DSLAM) and Central POTS splitter. The interface between each site is connected by an ATM/ADSL interface. The service at the remote site uses a 10Base-T Ethernet interface, and the service interface at the central site uses an ATM interface to connect the ATM public data network. B

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Bug Bounty Hunters

As software complexity grows, new testing tools help developers control bugs and costs alike.

By Derek Jones

Software testing may be one of the least attractive of all software-development activities. Yet, simply put, it's one of the most important parts of the development process.

Typically, it costs 10 times more to fix a bug at any stage of the development cycle than it does to fix it during the previous stage. But the cost of formal, comprehensive testing procedures can be prohibitive and often delays the time to market unacceptably. Automated software-testing tools can be a cost-efficient solution for developers looking to enhance the quality of their products. In addition, as application development becomes more intricate—especially with the growing complexity created by the move to applets and components—tools that systematically check source code or detect unexpected behavior at run time are becoming increasingly important for developers.

Software testing involves more than just debugging code. It encompasses the validation and verification of software throughout the whole development process.

Static vs. Dynamic Testing

So-called static analysis tools analyze the source code of an application. Static checks deal with such details as unreachable code, the misuse of pointers, undeclared variables, and variables used before initialization. The information gathered by these techniques serves two main purposes: to help developers understand the source code (e.g., by displaying a graphical representation of the control flow) and to act as an automated proofreader, looking for constructs that are likely to cause problems.

Commercially available tools either support a variety of programming languages or are specifically designed for a certain language. Generally, tools that focus on a specific language can better handle that language's special cases. Generic tools that support multiple languages, on the other hand, are more appropriate for working with a variety of programming languages. Generic tools include IPL's (Bath, U.K.) Cantata; Verilog's (Toulouse, France) Logiscope; and Battlemap, from McCabe and Associates (High Wycombe, U.K.). Tools for specific languages include PC-Lint, from Gimpel Software (Collegeville, PA), and QA-C and QA-C++, both from Programming Research (Hersham, U.K.).

PC-Lint offers an entry-level method of quality assurance on PCs. It detects a large number of common programming errors in C and C++ and gives developers a possibility to customize. Programming Research's QA series of tools are geared to large corporate development groups. They offer comprehensive customization features and can also generate metric information as well as graphical representations of code. In addition, both PC-Lint and the QA series of tools support cross-module checks.

Find Bad Pointers

Dynamic testing tools help you test a program's individual units and modules and, gradually, as modules come together, complete applications. Their big strengths include checking for bad pointers and memory leakage. In addition, they allow you to test the concurrent operation and integration of modules, check operation after a bug has been fixed, and perform stress tests.

There are two approaches to dynamic testing. One class of tools includes a compiler and uses source-code information to flag problems as it compiles. Another type of dynamic-testing tool checks the run-time behavior of executables.

Of course, a tool that checks source code has access to more information and can therefore do checks that are more thor-

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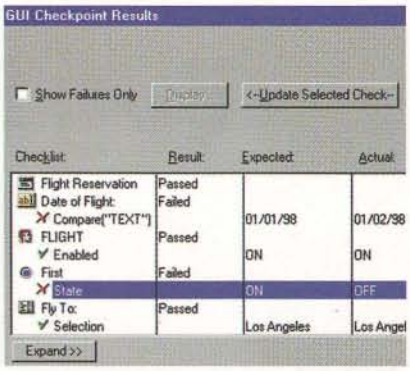
ough. A good example of such a tool is Bounds-Checking GCC, which was developed at the Imperial College (London); see http://www-dse.doc.ic.ac.uk/~rj3/bounds-checking.html. It's an extension to the GNU C compiler that adds pointer checks. By working at the source-code level, it can detect when, for example, a pointer has "walked" off the end of an object into another one. The disadvantage of this approach is that it requires access to source code, which may not be available if you use third-party libraries.

Tools that work at the executable level don't need information about the source. A case in point for testing executables is Purify, from Pure Atria (Cupertino, CA). Purify doesn't even need to know what language the original application was written in. Although it checks uninitialized variables down to the byte level, its pointer-checking capabilities don't go down to the level that the GNU C bounds-checking tools do. Instead, it treats contiguously allocated storage as a single memory item.

Is More Testing Needed?

How do you know how much testing has been done and how much more is still needed? There are a couple of techniques for measuring test coverage. *Statement coverage* counts how many of the total statements in the application are executed. Achieving 100 percent statement coverage shows that the tests are exercising every statement in the application, although it doesn't give you any measure of how much of the program structure was tested.

An interesting side effect of 100 percent statement coverage is that it helps programmers find statements that can never be executed. This is because defining test procedures to execute a given statement makes developers look at an application in a new light. It unavoidably leads to the question: Is this statement necessary? Some programmers say they remove almost 30 percent of the statements they find through this procedure.



GUI testing tools compare expected and real application behavior.

Path coverage, on the other hand, calculates the number of paths through an application. Achieving 100 percent path coverage for any but the simplest code requires enormous resources. In practice, you can use path-coverage measures only to check the testing level of the critical portions of an application.

Some tools insert code to flag that a statement or path has been executed to obtain coverage information, a process called *instrumentation*. The big problem with instrumentation is that it involves memory and CPU overhead. Fully instrumented programs typically run up to three times slower than noninstrumented ones. A good decision for software testing is, therefore, to completely instrument only critical portions of a program.

A case in point is ATAC, a publicly available tool written at Bell Communications Research for instrumenting C code. ATAC (http://www.clark.net/pub/dickey/atac/atac_961112.tgz) gives developers comprehensive coverage information by counting various bits of code being executed at run time.

Large sources and complex applications are naturally harder to test than software with simple functionality. *Software metrics* is one way of measuring the volume and complexity of an application. This procedure looks at the structure and linkage between the larger software building blocks rather than at the level of statements and expressions.

The two most often used metrics are the Halstead software science counts, which calculates code volume based on

Testing Java Applications

When granularity [of components] becomes so tiny [as when testing Java applications], the problems of integration testing are enormous," says Jeffrey Voas, chief scientist with Reliable Software Technologies (Sterling, VA), a software research and consulting company.

Testing Java applications is difficult because developers are forced to test applets on each configuration that they plan to support. This includes the different implementations of Java virtual machines (VMs)—browsers as well as compilers. In addition, because Java doesn't allow a testing class to gain access to private data and methods, developers must either add test methods to a class or change private classes to public classes. "Both of these options might modify the class so that some faults are not found," notes Jeffrey Payne, president of Reliable Software Technologies.

Another issue is that Java's built-in security mechanisms make the testing of applets trickier. Test tools can't easily write results to disk due to security constraints. "In addition, testing must be performed both inside of and through any corporate firewalls to ensure that applets will operate correctly," Payne adds.

To specifically address the problems of VM diversity, JavaSoft has launched the 100% Pure Java Certification program, which requires Java developers to ensure that applications are portable. SunTest, a subsidiary of Sun Microsystems, has introduced a suite of tools that helps developers not only gain certification but also perform overall quality testing.

JavaPureCheck checks that class files are indeed portable. It measures specified classes against a rule base. Classes that don't meet these rules are flagged, along with the construct that violates one of the portability rules. These errors and explanations are kept in a database that creates reports. You can download this tool for free from the SunTest Web site.

JavaSpin tests Java applications at run time. It's a low-end dynamic test tool that exercises a program through its GUI.

JavaScope is a coverage-analysis tool that includes method, branch, logical, and relational coverage (i.e., it looks at the usage of Boolean operators, which is effective for detecting boundary-condition failures). The current release does not support statement coverage, however.

JavaStar is a GUI record and playback tool. It includes a scripting language and compares the behavior of the program under test with the expected behavior.

JavaSpec uses the formal specifications of an API to automatically generate test programs. Developers can verify that an implementation of an API follows its written specification. JavaSpec was selected to create and maintain the entire Java API test suite for JavaSoft. **–Derek Jones and Rainer Mauth**

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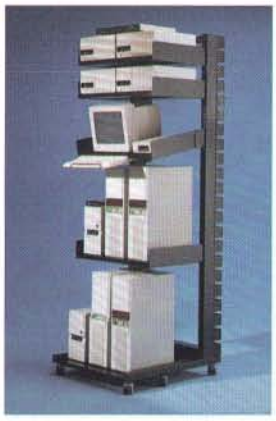

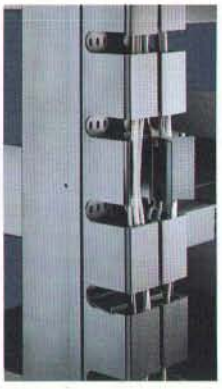

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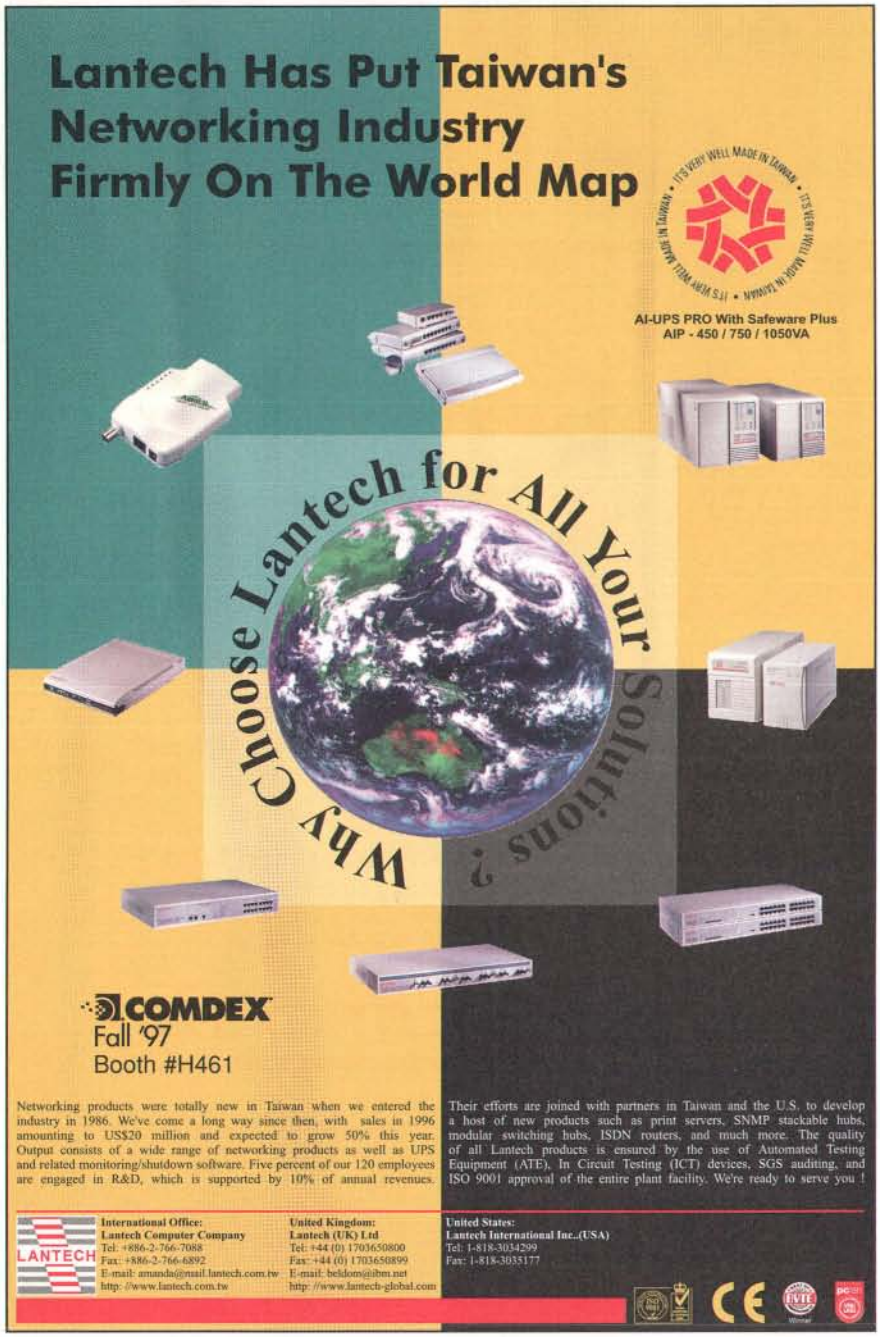
abstract operator and operand counts, and McCabe's cyclomatic complexity measure, which measures the number of control-flow nodes and edges.

If you're new to testing and have a complicated application to test, then metrics might help you find the most likely trouble spots within your code. The most complex and hardest-to-test modules of a program typically have the highest metric values. Once you locate potential trouble spots, you can break these modules down or rewrite the parts of a program that exceed predefined metric limits.

However, don't overestimate the value of metrics to software testing. Interestingly, many metrics correlate very highly to the number of noncommented lines of code. When evaluating a new software metric, always ask how accurate its predictions have been on historical data and to what extent it correlates with simple lines of code measurements. (Why use a complicated formula that doesn't give significantly better results than you can get from simply counting lines of code?)

You can also use metrics to estimate such things as the number of bugs likely remaining in code, the ease of software portability, or future maintenance costs.



How to Choose a Testing Tool

Customization: All tool vendors claim that their products can be configured to handle company coding standards. But the extent to which this is possible in practice varies enormously. When evaluating tools, always send the vendors a variety of code samples to process.

Metrics: Not all tools give the same figures for the same metrics. When evaluating tools, ask vendors to process some code for which you have calculated the metrics by hand. The subsequent discussion of their results will be revealing. In addition, some metrics correlate to a certain extent with simple lines of code measurements. Given these problems, there is little sense in spending lots of money on a tool that calculates only metrics.

Visualization: This is essential when working on path coverage. Good tools provide facilities for graphically viewing the results, highlighting statements or paths that have not been executed.

Analysis of conditions: Look for tools that analyze the conditions needed to reach a given block of code and that even go as far as suggesting values that variables must take. This can be useful when looking at nested conditions.

Language support: Unless your company has applications written in a variety of languages, a tool designed for a specific language will invariably provide better results than a generic tool set.

However, all major testing tools can generate metric information, so it doesn't make sense to spend a lot of money on a tool that calculates only metrics.

GUI Testing

A critical component of all software testing is the GUI. In GUI-based applications, users have control over several concurrent input devices, and applications can output results to multiple windows.

GUI testing is usually a three-stage process. First, the tool records all keystrokes, mouse movements, and button clicks into a script file. This recorded script can be played back to drive the application in test mode. This works well when an application behaves as expected.

The second stage involves adding checks into the recorded script for handling extraordinary conditions. These checks can

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include waiting for specific events to appear. It's also possible to add synchronizing points to handle cases where an application runs at different speeds.

In the third stage, the modified script runs against the application. The extent to which the script can reliably handle unexpected behavior depends on the effort you put into manually programming the script. The more sophisticated programs can graphically display differences between what the script expects and what the application sends to the screen. It's also possible to single-step through a script and display the values of variables, as simple debuggers do.

GUI testing tools, such as Mercury Interactive's (Or Yehuda, Israel) WinRunner for Windows and XRunner for Unix, enable developers to visually create test scenarios and verifications using a point-and-click method of selecting objects on-screen. They handle application changes automatically and maintain object-specific data independently of individual scripts to ensure that the same scripts can be reused even when an application changes during development.

Internet Adds Complexity

Current trends in software development challenge programmers as well as designers of testing tools. The Internet is dramatically increasing the pace of the software industry, and many developers believe that there is now even less time available for testing. Object-oriented design techniques, such as polymorphism, encapsulation, and inheritance, increase the complexity of testing through the extensive use of information hiding.

In addition, Java's "build once, run anywhere" paradigm complicates matters because it requires developers to test applications not only on all platforms but also on each virtual machine (VM) they might run on, including the VMs used in Web browers. As Java testers say, "build once, test everywhere." B

Derek Jones, a former compiler writer, is a testing expert with Knowledge Software, Ltd. (Farnborough, U.K.). You can reach him by sending e-mail to **derek@knosof.co.uk.**

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Greener Design

As consumers demand more environment-friendly products, new software tools help manufacturers build greener machines.

By Eric Johnson and Christina Seeberg-Elverfeldt

The pressure on European manufacturers to produce cleaner and greener products never lets up. A steady stream of new regulations focuses not only on issues such as waste disposal and air and water emissions, but also increasingly on companies' use of hazardous materials in their products.

Take, for example, the computer industry. Unlike the rules of the 1970–80s, the latest rules no longer apply only to manufacturing sites, where chips are made, circuit boards fabricated, or components assembled. As Walt Rosenberg, Compaq's director of environmental affairs, points out, "Environmental rules of the 1990s focus on the products themselves." Regulators want to see both greener PC manufacturing plants and greener PCs.

Additionally, users are demanding environment-friendly PCs. Led by public authorities in northern Europe, green-minded computer buyers have plumped for bans on certain materials, green guidelines for public procurement, and eco- and energy-label programs.

The key to reducing environmental and financial costs of manufactured products is the design process. "About 80 percent of a product's environmental costs are established in the conceptual-design phase," says Agis Veroutis of environmental consultant Roy F. Weston (West Chester, PA, U.S.). "The sooner in the design phase you start analyzing the environmental impact, the better the results."

Measure Environmental Impact

What designers therefore need is a yardstick to measure the environmental performance of a product design. A new breed of tools, collectively called design-for-environment (DfE) software, lets product developers analyze the environmental impact of their concepts. These tools comprise several databases of environmental evaluation factors and aim at product designers rather than environmental experts.

The core functions of DfE programs are eco-impact reduction and disposal optimization. However, out of the 15 tools we considered, only two of them, Ecobalance's DfE Tool and Boothroyd Dewhurst's Design for Environment, can do both.

This is not surprising, because the two functions of DfE software are distinct and independent tasks. Eco-impact reduction compares the environmental effects of a product's design options, using life-cycle assessment, or LCA. (See the text box "Life-Cycle Assessment" on page 32IS 24.) The idea of LCA is to find the design option that scores best when considering all effects on, for example, global warming, marine pollution, or waste-disposal problems.

In disposal optimization, the idea is to model and experiment with the disposal options for a given product. Typically, there are many possibilities.

You can dismantle or shred products or components, or deliver them whole for reuse, recycling, incineration, landfill, or any mixture thereof. In theory, the final optimized design should cause the lowest environmental burden and include the optimal number of reusable parts, no hazardous material, and a high degree of recyclable material.

You must do disposal optimization before you build the product. "Sometimes, just a slight reconfiguration of a machine's internals can make dismantling ever so much easier," says Mark Curtis, a senior partner at Boothroyd Dewhurst. But he warns that disassembly is not just assembly in reverse order. "Fasteners can get rusty, glues can refuse to unstick, and things don't always go out the way they came in."

continued

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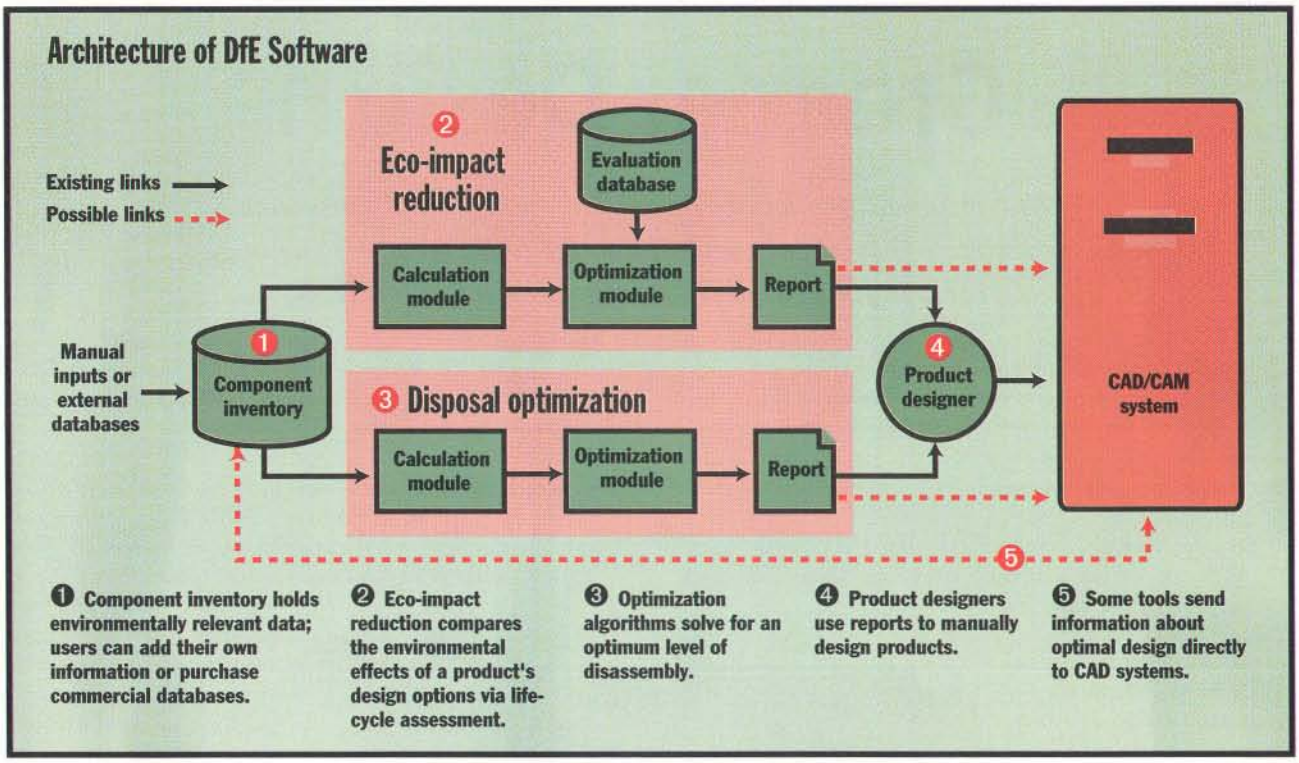

Architecture of Tools

At the core of DfE software is a component-inventory database. It holds large amounts of environmentally relevant data such as emissions, energy consumption, dismantling times, and recyclability indexes for electronics parts such as batteries, capacitors, and ICs.

A design module represents components visually and shows how they link together to form the product. This module retrieves the environmental information from the inventory database and displays it on the screen.

In eco-impact reduction, the software then aggregates eco-impact information into a few categories or even a single-number index. Two common indexes are Eco-Indicator, created in the Netherlands, and EcoPoints, developed in Switzerland. These indicators compare the eco-impact of a design to a fixed reference such as human- or eco-toxicity, thereby generating a relative score per eco-impact (e.g., for global warming or acid rain). The design with the lowest sum of these relative scores is best in environmental terms.

In disposal analysis, the software runs a sophisticated optimization process before aggregation and reporting. Several vendors have developed proprietary algorithms that model the component structure and solve for an optimum level of disassembly. Defining the optimum can be intricate. As Otto Meedt, one of the developers of Regred/DisPlay software from FAPS, points out, "If two aluminum parts are held together by an aluminum rivet, it may be better to recycle all three parts together rather than separating them."

It is on this optimization knowledge and expert judgment that DfE tools are competing. Many vendors supply proprietary component databases and optimization algorithms aimed at producers of electronics equipment. Vendors point out the paucity of public domain information in this area. "Environmental data on some components is costly to develop and commercially sensitive," remarks Martin Wielemaker, a director at Turtle Bay.

Naturally, product designers want to swap component databases around under one DfE system. But because systems are incompatible, this is not yet possible.

Standardization Is Coming

Four competing initiatives are addressing the standardization of component databases, not only for electronics but other industries as well. They are the LCAD

Life-Cycle Assessment

Life-cycle assessment (LCA) aims at comparing the environmental performance of products. It is an environmental accounting method that tries to quantify the inputs and outputs throughout the life cycle of a product, assess the effects of environmental loadings, and reduce the associated environmental burden. LCA is also the foundation for the eco-impact analysis in DfE software.

The methodology behind software tools that support LCA is to calculate the outputs during a product's life cycle and translate them into environmental effects or damage. That's why these tools need detailed information on manufacturing processes, materials, and energy use held in a large database that describes generic manufacturing processes and their emissions (see the figure "Architecture of DfE Software" above).

Because the evaluation depends so much on the quality of the database, critics say LCA usually reveals that whatever design you chose is best. Proponents, however, argue that LCA brings a desperately needed quantitative, rational element to environmental decision-making. Despite these debates, industry and government are increasingly accepting LCA, especially in Europe.

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group in the U.S., led by Battelle (Columbus, OH); SPINE, a Swedish group run by Chalmers University (Göteborg); the DALCA team in the Netherlands, led by research institute TNO (Delft); and the industry consortium SPOLD in Brussels. All these groups concede that, at best, a broad integration of databases will need some more years and that the more specialized the data, the less likely it ever will become public.

However, in an attempt to open the component inventory, some manufacturers have published their data. For example, about a year ago, Delta Electronics Testing published detailed material balances on about 50 components common to electronics goods, plus details on the hazardous content and disposability of each material.

The reason for the industry's and software vendors' sensitivity in this field is that information about hazardous materials is not always public. An electronics device, for example, has a number of hazardous materials (e.g., brominated flame retardants and sometimes cadmium and mercury compounds) that are not labeled and tend to be a problem to dispose.

Low-Cost Tools

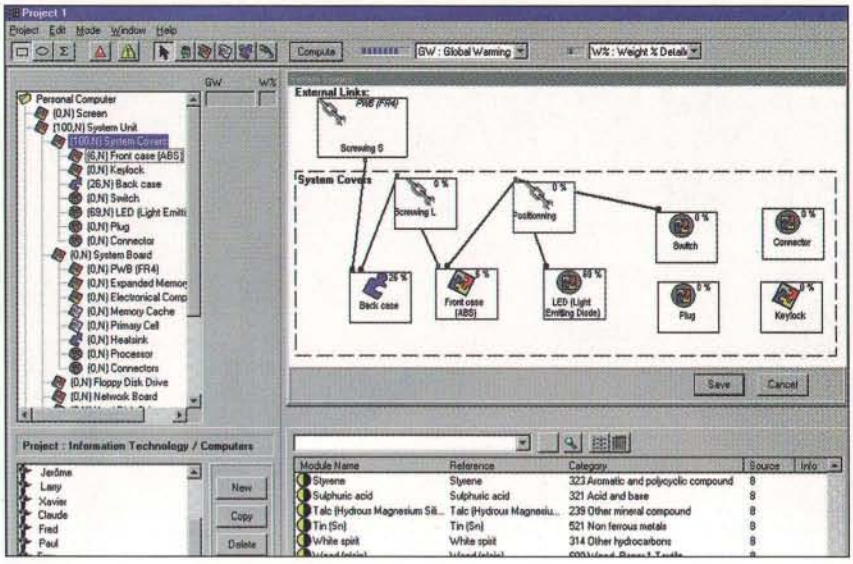
For now, say some vendors, the answer for manufacturers is to buy what they can afford and build the rest of the expert judgment internally. "Most companies will want to use their own expertise anyway," notes Remi Coulon of Ecobalance. "It all depends on how they view their environmental situation."

Vendors such as Conceptware, Decision Dynamics, Product Ecology Consultants, and Spinwest encourage users to start with their less-expert packages, which are considerably cheaper than the ones with built-in expert systems. This is especially helpful if a vendor's proprietary component inventory doesn't meet a manufacturer's environmental compatibility standards. In this case, companies can buy cheap software and build their own expert judgment and database.

Another competitive factor is integration with CAD systems. This is especially important if designers use DfE tools on a day-to-day basis. Says Stefan Utzinger, the managing director of Conceptware, "CAD integration is a way of building the environmental expert right into the designer's desktop."

Thus far, only Nortel/Cognition's Eco-Design Tool and Savantage's SavanSys have a direct link to Intergraph's CAD system Pro Engineer. However, Boothroyd Dewhurst, Ecobalance, and FAPS have all built their offerings with CAD linkage in mind.

DfE tools are proliferating. By the end of the year, there will be about 15 commercially available tools. While some industry experts expect a shakeout of DfE tools during 1998, the user base for DfE tools will be growing steadily. Says Weston's Veroutis, "At the end of this century, every electronic product manufacturer will have a DfE system in place." B



New design-for-environment tools help product designers create environmentally friendly products.

WHERE TO FIND

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News & Views

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This month we look at software to stimulate creativity and a removable Jaz drive.

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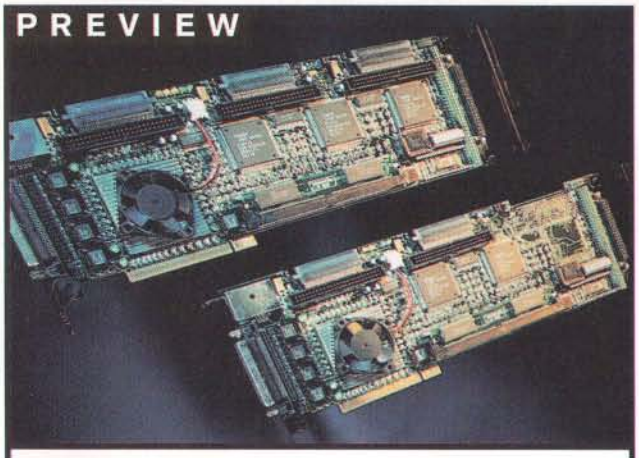

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RAID Controller Runs Intel 960RP Chip

The GDT RP is one of the first RAID controllers to run Intel's 960RP chip. It consists of a 30-MIPS RISC processor with local memory, a PCI-to-PCI bridge, and built-in support for interrupt handling and DMA transfers. The new chip makes the GDT RP compatible with the upcoming I_2O I/O standard. But since OSes for I_2O are not ready for market yet, you'll have to wait several more months to capitalize on I_2O's performance and manageability benefits.

The GDT RP bridges I/O gaps between the CPU and disks via high-speed bus transactions and intelligent caching algorithms. This new PCI board can carry up to 64 MB of cache memory, implemented either as fast-page-mode or EDO SIMM modules. If 64 MB is not enough, an optional PCI module lets you extend cache memory to a piggyback board. In addition, the caching algorithm includes adaptive delayed-write and read-forward functions. You can now buy the board in Wide and Ultra SCSI versions; a Fibre Channel version will be available by the end of the year.

With ICP Vortex's RAIDYNE firmware installed, disk arrays with RAID levels 0, 1, 4, 5, and 10 work independently of the host machine. You can plug in extra disks and change RAID levels during operation. It also enables you to assign a spare disk to a single RAID cluster or define a pool of extra disks that can be used by all clusters in case of failure.

Because the GDT RP comes in several variants with up to five independent SCSI channels, it's a scalable solution. It works in midsize file servers as well as in high-end database servers with a capacity of more than 25 GB.

–Rainer Mauth

Communications

Serial Ports Connect to PCI

BRAIN BOXES' FOUR-PORT RS-232 I/O card provides high-speed serial-port connectivity and plugs into the PCI bus. It transfers data at speeds up

to 115.2 Kbps, includes a 16-byte FIFO buffer, and comes with software utilities for DOS and Windows 95, NT, and 3.11.
Price: £265.
Contact: Brain Boxes, Liverpool, U.K., +44 151 220 2500; http://www.brainboxes.com.
Enter 1019 on Inquiry Card.

Three Interfaces in One Card

THE MC218 CARD COMBINES ANALOG, ISDN, and GSM interfaces in a single PC Card. It offers a 33.6-Kbps data transfer rate on Public Switched Telephone Networks and includes automatic recognition of the line interfaces of different countries. At speeds up to 128 Kbps on ISDN networks and 9600 bps on GSM, the MC218 meets standard data-transmission rates. It ships with Windows 95–compatible software that supports faxing and electronic file transfer.
Price: Call company.
Contact: COM One, Bordeaux, France, +33 556 78 84 00; http://www.com1.fr.
Enter 1020 on Inquiry Card.

Remote-Access Router for the Home Office

VICAS, A TELEWORKING ACCESS SYSTEM, combines a remote-access router with a phone switch and a fax machine. It provides ports for one ISDN line, two telephones, a serial connector, and two Ethernet connectors. Because the device supports the TCP/IP and SNMP protocols, it enables teleworkers to access the Internet as well as remote LANs. Vicas includes several security features and is intended for remote offices and small call centers.
Price: DM 3450.
Contact: BinTec Communications GmbH, Nuremberg, Germany, +49 911 967 30; http://www.bintec.de.
Enter 1021 on Inquiry Card.

Networking

A New Family of Ethernet Cards

HYPERTEC'S HYPERNET RANGE OF NETwork adapters provides Ethernet connectivity for small businesses. The entry-level HyperNet PnP Combo ISA-bus card provides 10Base-2, 10Base-5, and 10Base-T connectors; HyperNet PCI, the PCI-bus version, supports 10Base-2 and 10Base-T. At the high end of the range, the HyperNet PCI 10/100, a Fast Ethernet version, includes 10Base-T and 100Base-TX connectors for data transfer rates up to 100 Mbps.
Price: HyperNet PnP Combo, £29; HyperNet PCI, £40; HyperNet PCI 10/100, £49.
Contact: Hypertec, Ltd., Hungerford, U.K., +44 1488 686844.
Enter 1022 on Inquiry Card.

Storage

Removable Jaz Drive

FINALLY THERE'S A SWAPPABLE VERSION of the Iomega Jaz drive. Using an internal or external Swap Bay, the Swap Jaz Drive lets you remove the

entire drive and plug it into any other bay-equipped computer, much like a removable car stereo.
Price: Starts at DM 730.
Contact: Computer Connections, Ratingen, Germany, +49 210 242 990; http://www.storagecompany.com.
Enter 1010 on Inquiry Card.

Security

UPS Includes Remote Monitoring

OFFERING SOPHISTICATED COMMUNICATIONS facilities via the RS-232 port, the Ofys Micro UPS provides complete control over all kinds of power electronics. Its supervisor software includes remote monitoring and shutdown features and guarantees fault-free operation in case of system failure. The package offers real-time graphs of operating status and alarms plus scheduling of shutdowns and start-ups.
Price: Call company.
Contact: Sicon-Socomec, Villaverla, Italy, +39 445 359111.
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PC Board Encrypts CD-ROMs

CDCRYPT, AN ENCRYPTING BOARD FOR CD-ROMs, supports ISO-9660 formats and protects access to CD-ROM content with a 112-bit algorithm. The professional version contains encrypting and decrypting software, two smartcard readers to store keys, and the PC board, which encodes 650 MB in approximately 8 minutes. The software package alone is available as a Personal Edition, including a database for keys and addresses.
Price: Starts at DM 2070.
Contact: CE Infosys GmbH, Bodenheim, Germany, +49 6135 77 0.
Enter 1027 on Inquiry Card.

Input Devices

A Mouse for Notebooks

MOUSEMAN, A MOUSE FOR NOTEBOOKS, weighs less than a standard mouse and includes a short, 60-cm-long

cable. The three-button input device executes frequently used key combinations in Windows 95 or Netscape Navigator at the click of a button.
Price: DM 79.
Contact: Logitech, Romanel-sur-Morges, Switzerland, +41 21 8635111.
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Scanners

Large-Format Scanner

HANDLING DOCUMENTS UP TO 36 INCHES in width and of unlimited length, the Imtec 3730C large-format scanner supports black and white, 256 gray scales, and 24-bit color. Scanning an A0-size document in 400 dpi, for example, takes 24 seconds in monochrome. The device uses photo transistors for color scanning that offer superior picture quality.
Price: £11,000.
Contact: The Imtec Group, Ltd., Stanmore, U.K., +44 181 204 3456.
Enter 1025 on Inquiry Card.

SOFTWARE Engineering

TPCAD Optimizes Motor Design

TPCAD ENGINEERING SOFTWARE HELPS optimize three-phase induction-motor designs and predicts the performance of motors when the design changes. The program simulates test conditions and calculates the weight and cost of materials for a given design. You can purchase the analysis, optimization, and test modules separately or as a package.
Price: Call company.
Contact: Information Technologies and Electronics, Ankara, Turkey, +90 312 210 1310.
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Silux Simulates Multibody Dynamics

SILUX SIMULATION SOFTWARE HELPS SOLVE mechanical-design problems with new algorithms that include the detailed analysis of multibody dynamics. The package runs on Windows NT and Power Macs and allows for the detailed mechanical stress analysis of parts as well as entire systems. Silux interfaces with DXF and IGES for data exchange.
Price: Starts at 4000 SFR.
Contact: Silux AG, Zug-Oberwil, Switzerland, +41 52 366 0330; http://www.silux.com.
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Security

Protect Your Domino Databases

DR. SOLOMON'S ANTI-VIRUS TOOLKIT FOR Lotus Domino protects databases and mail against viruses. It monitors all incoming and outbound mail and attachments in the background, and it either isolates or deletes viruses in case of infection. Other features include on-access and on-demand scanning of Notes databases. The program runs on Windows NT networks; versions for OS/2 and NetWare will be available soon.
Price: £395 (10-user license).
Contact: Dr. Solomon's Software, Ltd., Aylesbury, U.K., +44 1296 318700; http://www.drsolomon.com/.
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ServerProtect Keeps NT Networks Clean

SERVERPROTECT FOR WINDOWS NT INcludes several remote management functions that help prevent virus in-

fection on large NT networks. The software detects macro viruses as well as viruses hidden in compressed or encoded files. You can download updates of the latest virus scanners from the vendor's Web site.
Price: Call company.
Contact: Articon Information Systems GmbH, Aschheim, Germany, +49 89 945 730; http://www.articon.de.
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Image Processing

Analyze High-Resolution Images

THE DIMPLE 3.0 IMAGE-PROCESSING PROgram runs on Windows as well as on the Mac OS. It processes 32-bit images and includes annotation features for producing detailed maps. The program handles and analyzes various data types: satellite, airborne, radar, or data from geological or geochemical research. The implemented scripting language lets users integrate their own functions into the menus.
Price: £1395.
Contact: Cherwell Scientific Publishing, Ltd., Oxford, U.K., +44 1865 784800; http://www.cherwell.com.
Enter 1030 on Inquiry Card.

Web

Java Booster Speeds Up Downloads

IF YOU REGULARLY DOWNLOAD A MULTITUDE of Java applets, Innovative Software's Java Booster may help you.

This utility caches Java applets, stores them in your Windows NT or Unix networks, and makes them accessible to all users on your network. The software also offers an off-line mode, text retrieval, and comprehensive import and export features.
Price: Client version, DM 49; server version, DM 790.
Contact: Innovative Software GmbH, Frankfurt/Main, Germany, +49 69 23 69 29; fax: +49 69 23 69 30; http://www.isg.de.
Enter 1015 on Inquiry Card.

Project Management

Calculate Effects of Delays

PROJECTDIRECTOR FOR WINDOWS OFFERS sophisticated time-management facilities and calculates the effects of potential delays. The software allows for an unlimited number of links between individual tasks and detects conflicts automatically. A built-in communications interface lets you send e-mail directly from the program.
Price: Call company.
Contact: Planetary Systems, Budapest, Hungary, +36 1 313 8049; http://www.plansys.hu.
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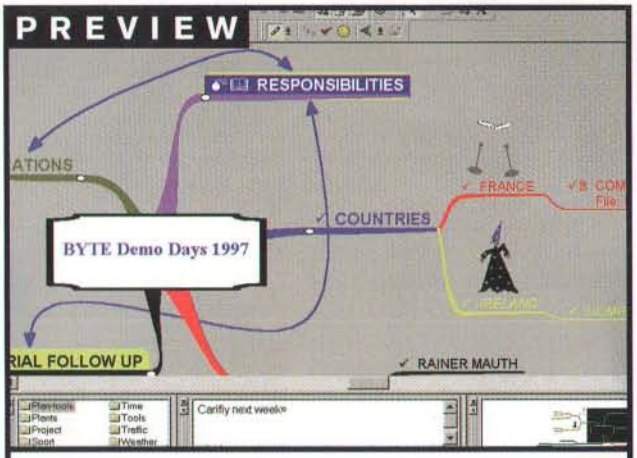
Business

CreditSim Analyzes Finances

CREDITSIM BUSINESS-SIMULATION SOFTware helps analyze the long-term effects of management decisions on corporate finances. It displays the results in graphs and tables that are dynamically linked to the decision-input module. The program requires a Pentium PC with a minimum of 16 MB of RAM.
Price: About DM 1400.
Contact: Paradigm Business Simulators AS, Bergen, Norway, +47 553 065 00; http://www.paradigm.nl.
Enter 1036 on Inquiry Card.



MindMan 3.0
Price: DM 129

Enter 1013 on Inquiry Card.

Visualizing Ideas
Karlsfeld, Germany
+49 8131 505047
fax: +49 8131 505046
susan@mindman.com
http://www.mindman.com

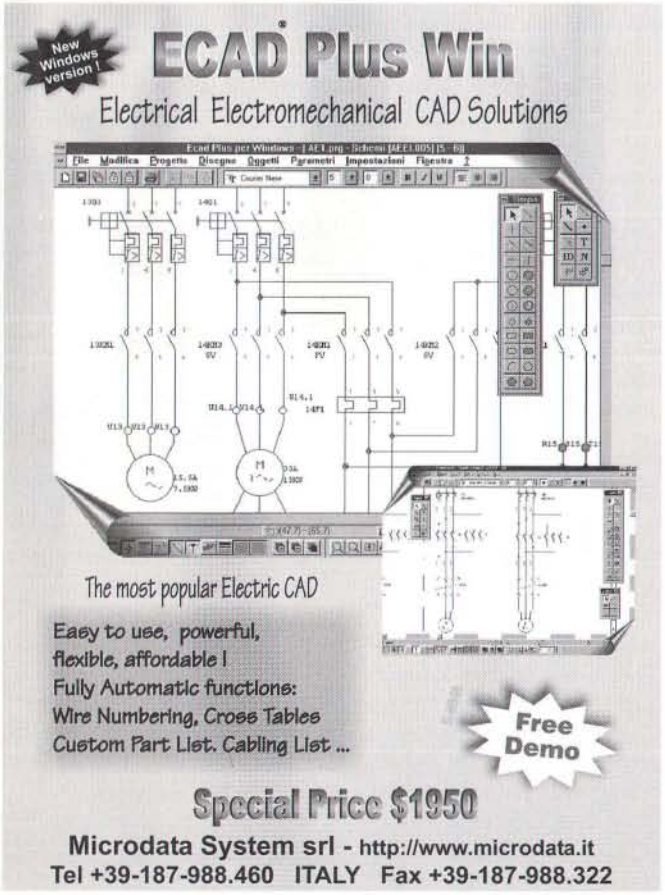
MindMan Helps Manage Creativity

The concept behind mind mapping is as simple as it is enticing: Instead of using traditional lists and other forms of note-taking during brainstorming sessions and general idea conception, use color, curved lines, and suggestive symbols to be more creative. This mirrors the way in which the mind works and lets you harness your creativity to the best advantage.

Whereas traditional mind mapping involves the use of paper and colored pens, MindMan 3.0 uses all the bells and whistles of the Windows 95 GUI to stimulate and visualize your ideas. With MindMan you can drag and drop branches to reorganize your ideas quickly, drag and drop objects from other applications, create hyperlinks to external documents and Web pages, link multiple mind maps, and define relationships between items or branches. The tool also lets you attach textual notes to items and branches and automatically assigns symbols to keywords.

Because creative processes are often more efficient when done with teams, MindMan has a conferencing system that allows for real-time editing and collaborating of shared mind maps via the Internet.

The beta version I tested didn't include any tutorials, which may be helpful if your're new to mind mapping. However, MindMan is impressively easy to use, and its concept of user interaction is consistent. The quality of the symbol library needs work, however. Most icons are just blunt and sober bit maps. **–Rainer Mauth**



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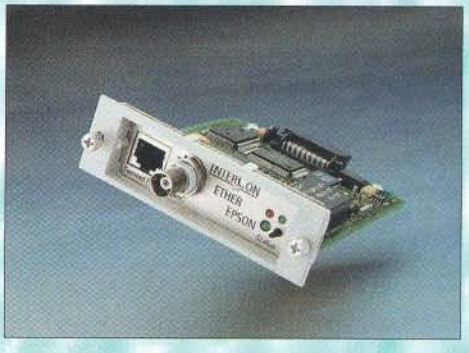
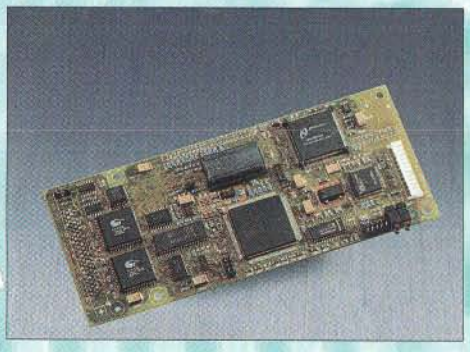


Features

- Configurable with any HTML 3.x Internet browser
- Multiprotocol support of all operating systems
- Automatic recognition of the used network connector
- Software update/upgrade via download in Flash-EPROM
- Printer status request from host computer
- Automatic protocol recognition
- Configuration parameters can be edited by software
- Configuration via printer operation panel (for KYOCERA)
- Recognition and reaction to network environment changes
- Supports 16 queues on 16 servers (Novell)
- Support of 8 logical printers
- Easy Installation via PCONSOLE (Novell)
- Status button



Software Support

- **Novell** 4.x NetWare Directory Services (NDS)
- **Novell** 2.x, 3.x, 4.x Bindery Mode
- **SNMP** (MIB II and SEH Privat MIB)
- **HTML/HTTP** configurable
- **UNIX** (TCP/IP)
- **Apple** Ether/TokenTalk
- **Windows NT** (TCP/IP)
- **Windows '95** (SEH PrintMonitor)
- **BS2000 RSO Spool** (V. 2.3A, V. 3.0A)

Hardware Support

Ethernet 10Base2/5/T/FL (BNC, AUI, RJ45, ST)

- IC53-ETHER-KYO-5
- IC53-ETHER-KYO-FL
- IC55-ETHERPOCKET
- IC57-ETHER-EPSON

Token Ring STP, UTP (IBM Type1/2, Type3)

- IC60-TOKEN-KYO

Ethernet 100BaseTX (RJ45)

- IC73-FAST-KYO-TX
- IC77-FAST-EPSON-TX

More information about InterCon:

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Südring 11 D-33647 Bielefeld, Germany
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Fax: +49 / 521 / 94226-99
Internet: http:// www.seh.de
E-Mail: info@seh.de
Compuserve-Id: 100742,1452

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BYTE

11/97

A Division of The McGraw-Hill Companies

With raging video playback and your choice of either AGP or PCI, the Revolution 3D runs circles around the competition. By David Em

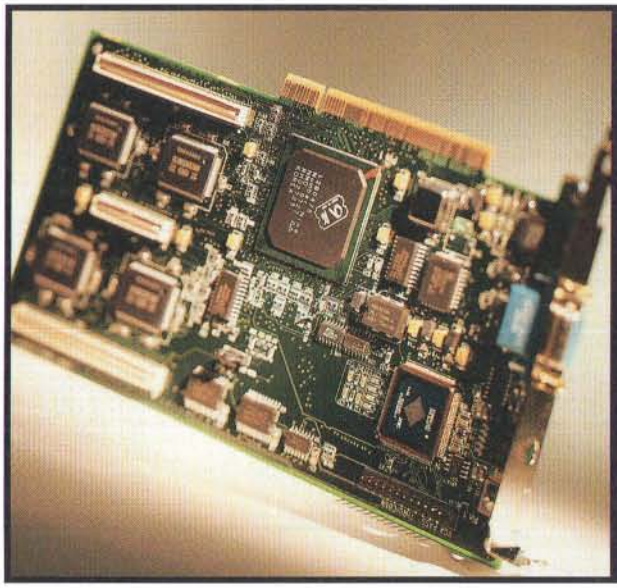
Number Nine's New Spin: Revolution 3D

According to Moore's Law, computing power doubles every 18 months. When it comes to computer graphics, however, it triples. As a result, graphics horsepower that was once available only on high-end workstations now exists at the consumer level.

One of the first of the new generation of graphics subsystems to include the Accelerated Graphics Port (AGP) is the Revolution 3D card from Number Nine Visual Technology. The Revolution 3D comes in single-slot AGP and PCI versions. It incorporates a third-generation 128-bit chip called Ticket to Ride.

The Revolution 3D comes in dual-ported Window RAM (WRAM) configurations ranging from 4 to 16 MB. I tested both the 8-MB PCI and AGP versions of the card, and ran both cards at 1280- by 1024-pixel resolution and 85 Hz.

The Revolution 3D's 2-D performance is spectacular. Screen refreshes are as fast as any I've seen, and at 85 Hz, the display is rock-solid. Programs such as Adobe Photoshop and MetaCreations' Painter 5 were very responsive.



Revolution 3D
$449
(8 MB)

Number Nine Visual Technology Corp.
Lexington, MA

800-438-6463
617-674-0009
fax: 617-674-2919

http://www.nine.com

Enter 1074 on Inquiry Card.

The Revolution 3D's engine processes video scaling as a texture and greatly reduces pixelation.

Video playback was similarly impressive and included RGB MPEG decompression. I played both Audio Video Interleave (AVI) and MPEG clips scaled to full screen at 1280 by 1024 pixels in true color on Windows 95. At 30 frames per second, the motion was extremely fluid.

Serious 3-D users will want to consider the 16-MB card, which can support double-buffered color at 1280 by 1024 pixels, or up to 1920 by 1060 pixels at 65,000 colors. The Revolution 3D supports OpenGL, Heidi, and Direct3D drivers, although Windows NT does not yet have hardware support for Direct3D.

The floating-point setup engine reduces the performance hit experienced when multiple 3-D features are enabled. The combination of the128-bit, 2-D drawing engine and the WideBus internal architecture allows the card to process graphics and video data at up to 1.56 GBps.

The PCI and AGP versions of the 4-MB Revolution 3D sell for $349. The 8-MB version costs $449. An 8-MB upgrade to 16 MB is an additional $249. The Revolution 3D can't compete with the highest-end 3-D graphics cards from such companies as Intergraph and Dynamic Pictures, but it costs only about a quarter as much. Its performance is well suited for artists, graphic designers, and desktop publishers who need good 3-D and scorching 2-D and video. B

RATINGS	
TECHNOLOGY	★★★★★
IMPLEMENTATION	★★★★
PERFORMANCE	★★★★

David Em (Sierra Madre, CA) is a digital artist and writer. You can reach him at **davidem @earthlink.net.**

TECH FOCUS

AGP or More Memory?

The MMX/AGP combination should improve graphics and video performance, and bring down the price of memory and bandwidth-intensive functions such as texture mapping. However, there are currently no applications to prove this. I tested the Revolution 3D card on a 300-MHz Pentium II machine with AGP. At one point, I even turned off its 3-D features. Despite all the available power and bandwidth, graphics slowed to a virtual crawl. Budget-conscious serious gamers and professional graphics users looking to buy new systems are far better off sacrificing a little speed on the CPU end and putting their money into the fastest graphics card they can afford.

PHOTOGRAPH: MICHAEL MAYO © 1997

Using new CMOS sensor technology, the SVmini-209 delivers high-quality pictures at a low price. ***By Stan Miastkowski***

CMOS Gets the Picture

Until recently, digital still cameras were either inexpensive, low-resolution devices or high-end units for people who need professional-grade images. But a new camera from Sound Vision, the SVmini-209, delivers ultrahigh-quality digital images at a relatively bargain price. Sound Vision itself sells the SVmini and also OEMs it to Vivitar and others.

The key to this camera is its CMOS sensor, developed with VLSI Vision (Edinburgh, Scotland). The model I tested is Sound Vision's second-generation camera. The first, sold as the Vivitar ViviCam 3000 and Umax Sharpset 8000, was the first digital still camera on the market to use a CMOS sensor instead of a charge-coupled device (CCD) sensor. High-resolution CMOS sensors are less expensive than comparable CCDs, and they also require considerably less power and support circuitry, which means dramatically increased battery life.

The SVmini-209's four-color sensor produces a native resolution of 1000 by 800 pixels (10 bits per color). A Texas Instruments TMS-320C209 digital signal processor extrapolates the image to 2000 by 1600, a truly impressive 3.2-megapixel image. A noise-reduction algorithm in the camera software removes graininess from images taken in poor light.

The camera holds 1 MB of DRAM and 1 MB of flash memory. System software takes 1.5 MB, leaving about 500 KB for image storage. The SVmini uses variable JPEG compression, which you adjust using either an on-camera LCD or a serial connection, to balance image quality against storage space: 80 percent compression (100 KB per image) gives optimal quality; 40 percent (50 KB) produces some artifacts. The 500-KB internal memory isn't much space for images, so the SVmini has a slot for flash memory cards holding 2 to 16 MB. An adapter will be available for SanDisk MiniPort cards, which use a DOS-compatible file format.

The SVmini-209 sports an f/4.0 fixed-focus glass lens, a built-in flash, and a self-timer. There's a built-in microphone for recording brief clips of WAV audio along with each image (although this eats into image-storage space). Windows 95 software included with the camera lets you download and view images through a serial port, set all the camera's parameters, and clear images from memory. Macintosh software is also available. An optional AC adapter extends the life of the six AA batteries.

The camera I tested, an early prototype, produced superb images in a variety of lighting conditions. While its CMOS sensor technology is new, the SVmini is obviously riding the wave of the future. B

It's small, but the SVmini camera captures high-resolution digital images with good color.

RATINGS	
TECHNOLOGY	★★★★★
IMPLEMENTATION	★★★★
PERFORMANCE	★★★★★

TECH FOCUS

Don't It Make Your Brown Eyes Blue?

A digital camera tries to record colors the way the human eye sees them. Since the retina has three different color receptors (red, green, blue), you'd assume a camera also needs three receptors. Unfortunately, the dyes in a camera's sensors don't match the eyes' color response very well.

Sound Vision adds a fourth dye, teal. This extra measurement helps achieve a better color match. Interestingly, some women's eyes have four color receptors, a condition called tetrachromaticity. Some geneticists speculate that such women can better assess their children's health by skin tone.

Stan Miastkowski is a BYTE consulting editor. You can reach him at **stanm@bix.com.**

PHOTOGRAPH: MICHAEL MAYO © 1997

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

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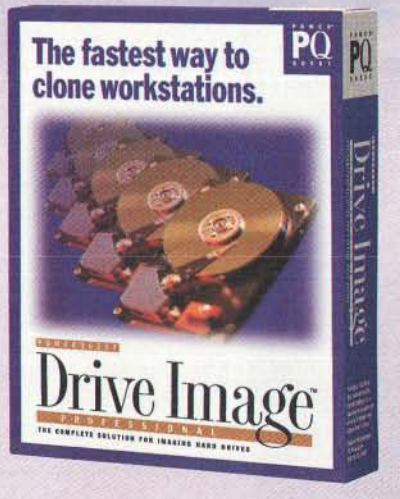

Drive Image Professional is available for use by a single technician on an unlimited* number of workstations.

*Persons or entities who image or configure more than 5,000 computers each year for the purposes of fee-based services must purchase a Drive Image Master License Agreement.

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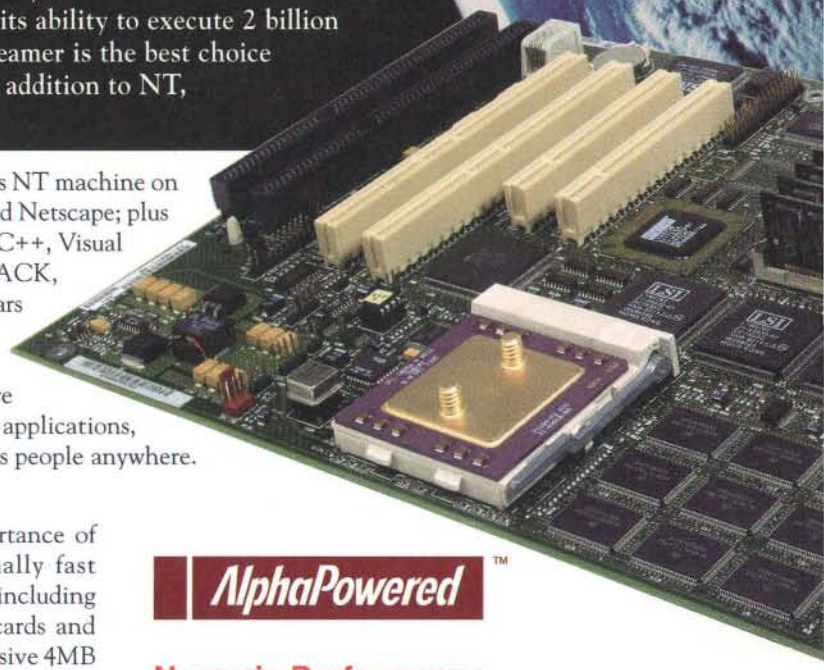

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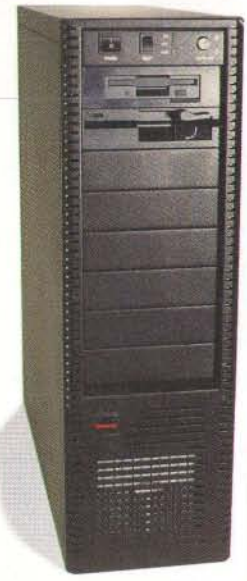

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This word/idea/document processor is something else, but we're just not sure what to call it. ***By Russell Kay***

A Whatchamacallit for Words

Dan Bricklin created the electronic spreadsheet as we now know it. His subsequent software products have all been distinct and different—category makers and breakers. So, too, is his latest brainchild, Trellix. There's no category label that clearly conveys what Trellix does. In brief, it lets you create hypertext documents that function like a Web browser, outline processor, and presentation-graphics package rolled into one, complete with instant links to other parts of a document or accessible URLs.

Paper documents are mostly read from beginning to end, while Web sites are clearly nonlinear: You branch back and forth, and when you find an interesting link, you click on it and bring it up. This navigation ability is the essence of Trellix, which is designed for on-screen viewing.

A Trellix document appears in two parts: a map that shows the document's structure, and the pages. Each page can have up to four borders (which are typically quite wide) that house navigation buttons, text elements, or graphics. There is also an optional outline view. The map shows each page as a small rectangle, highlighting the current page in yellow, indicating sequential links by connecting lines, and representing structure by a vertical hierarchy. When your cursor hovers over a page icon on the map, a label appears with that page's title. Put your cursor on an underlined link, and the corresponding map icon is also highlighted.

When creating a document, you can write pages in any order and rearrange them by dragging and dropping icons on the map. You can import content from existing documents in a variety of formats. Menu items make it easy to create links and sequences of pages. It's easy to present summary information without interrupting the flow of the document. And it's even easier to incorporate auxiliary information and footnote-like references that don't get in the way.

Trellix lets you program complex documents for the reader. You can create different viewing sequences (Trellix calls them tours) in the same document, for different purposes or audiences. You can print a Trellix document, but you would normally view it with Trellix itself, a free viewer, or as an exported HTML page that any browser can display.

Trellix isn't a normal word processor for writing letters, e-mail, or the Great American Novel, nor is it a PowerPoint replacement. But it offers a powerful new potential for presenting and viewing structured information, from research reports to textbooks to business plans.

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http://www.trellix.com

Enter 1042 on Inquiry Card.

Trellix organizes information with a document map, hyperlinks, an outline view, and dedicated screen areas.

RATINGS	
TECHNOLOGY	★★★★★
IMPLEMENTATION	★★★★

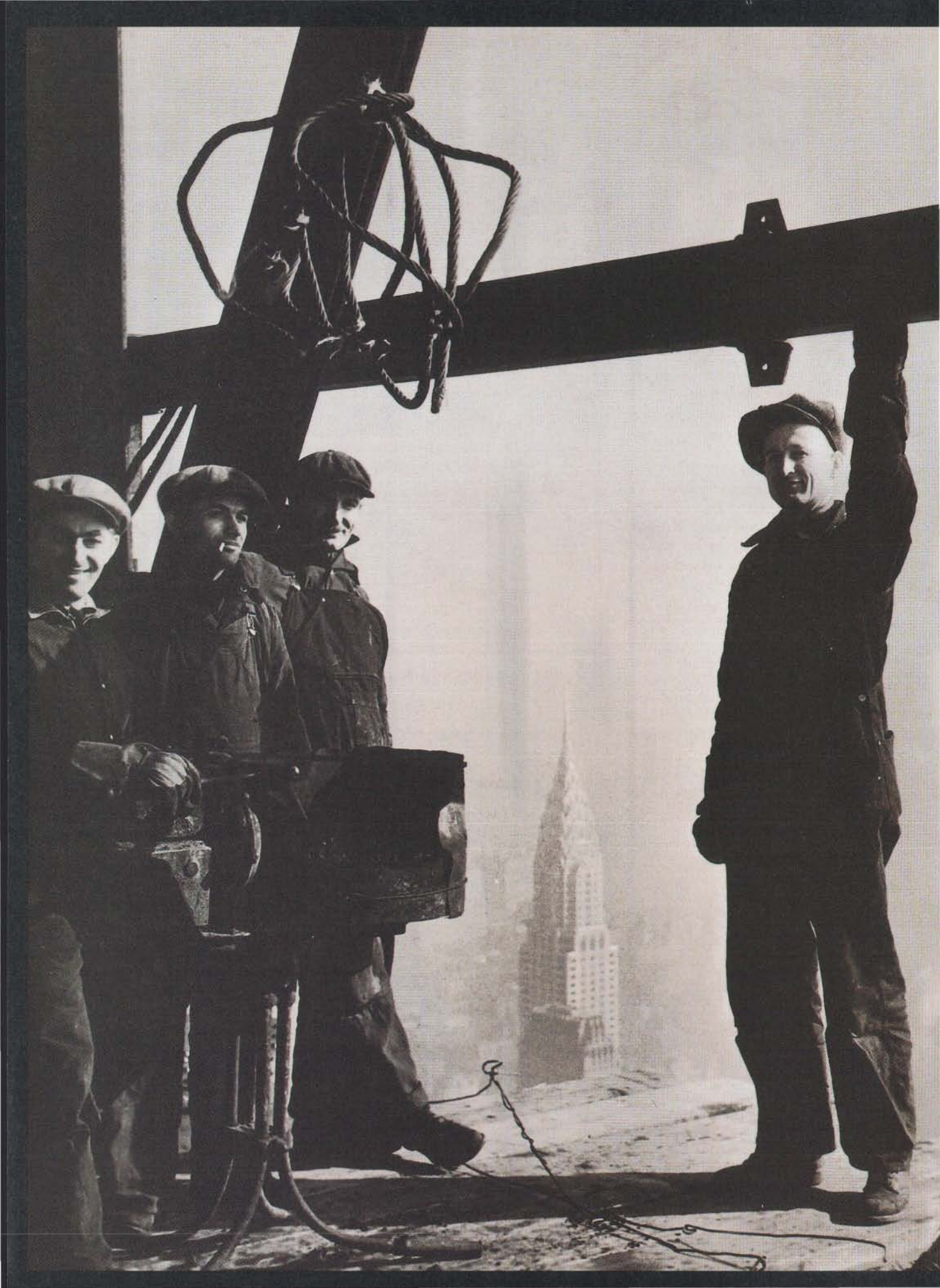
I drafted this Eval using the "sneak peek" version 0.8, which didn't implement all the package's promised features but was easy to use without a manual. If the final release lives up to this early promise, Trellix will be a useful tool that could revolutionize many kinds of writing and presentation. B

Russell Kay is a BYTE technical editor in the reviews department. You can reach him by sending e-mail to **russellk@bix.com.**

TECH FOCUS

Looking at a Very ActiveX

Trellix, a set of ActiveX controls that are containers for each other, is one of the first applications to support Microsoft's ActiveX Hyperlinking Protocol. A Trellix document is an ActiveX document; therefore, it can link to (or be linked from) other Trellix or ActiveX documents, including video, spreadsheets, and various graphics, or it can contain URLs pointing to Web pages. You can also include a Trellix document within another ActiveX container, such as a Microsoft Office Binder document.



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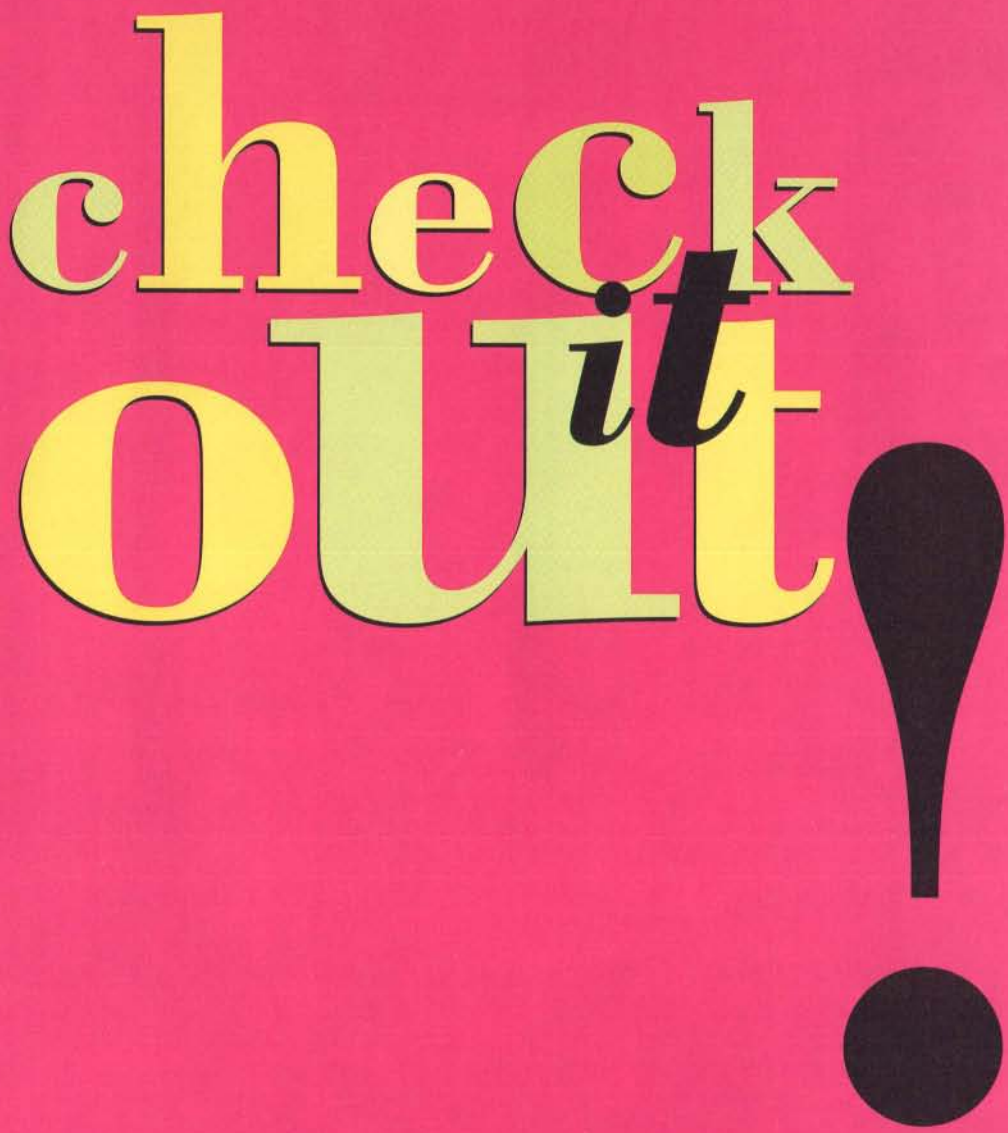
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A new ATM service enables applications to compensate for network congestion. ***By William Stallings***

Adjustable Cell Rates for ATM Networks

Nowadays, when you use an asynchronous transfer mode (ATM) network, you have a choice from four classes of service for carrying traffic. The first one is constant bit rate (CBR), which specifies a fixed data rate. The ATM provider's network must ensure that this capacity is available and polices the incoming traffic on the connection to ensure that the subscriber does not exceed its allocation.

The second service is the more flexible variable bit rate (VBR). A VBR connection defines a sustained rate for normal use and a faster burst rate for occasional use at peak periods.

The third one is unspecified bit rate (UBR). This is a best-effort service: No amount of capacity is guaranteed, and any cells may be discarded. Finally, a new ATM service has been defined: available bit rate (ABR). It provides a guaranteed minimum capacity. When additional network capacity is available, you can burst data above the minimum rate without risk of cell loss. Each service has its uses, as seen in "Four Types of ATM Service."

ABR and UBR are best suited for LAN internetworking and other types of data traffic. UBR is directed at delay-tolerant applications (e.g., file transfer and e-mail). It provides no feedback about network congestion to the user or application. Thus, UBR increases the risk of discarded cells, which in turn increases network traffic because of the lost cells that must be retransmitted. To improve service to bursty sources that would instead use UBR, ABR was defined.

ABR is intended for applications where network delays are a concern. The main practical difference between ABR and UBR is that, in the case of ABR, the network provides congestion information to the application. This lets the program constantly modify the sending rate, achieving the best throughput.

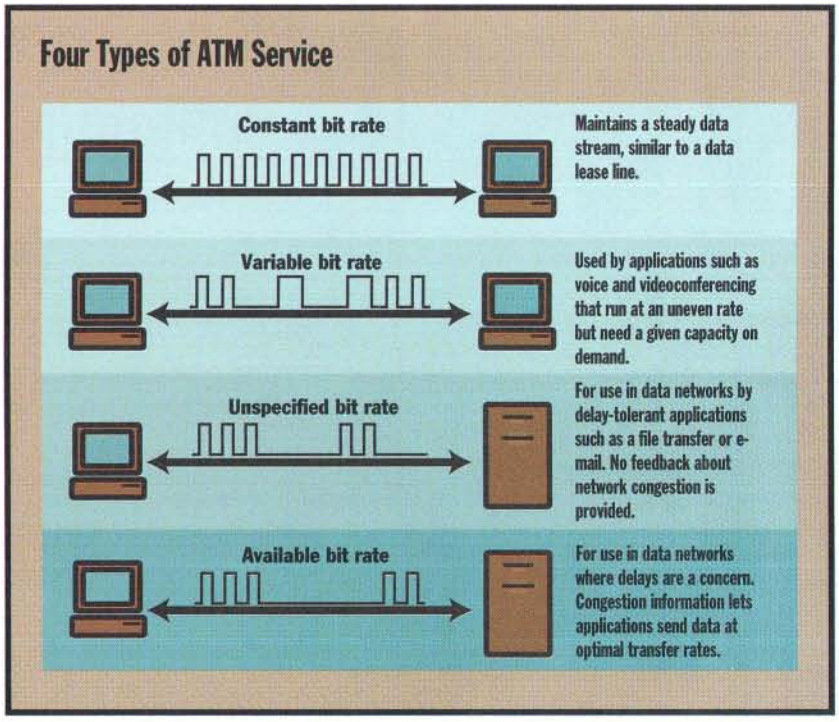
ABR Rate Control

An application using ABR specifies a peak cell rate (PCR) that it will use and a minimum cell rate (MCR) that it requires. The network allocates resources so that all ABR applications receive at least their MCR capacity. It then shares any unused capacity in a fair and controlled fashion among all ABR sources.

The ABR mechanism uses explicit feedback to the sources to assure that capacity is fairly allocated. Any capacity that ABR sources don't use remains available for UBR traffic. An example of an application using ABR is a LAN interconnection. In this case, the end systems attached to the ATM network are routers.

The ABR service offers a number of benefits. First, ABR connections share available network capacity. They have access to the instantaneous capacity unused by CBR/VBR connections. Thus, ABR can increase network use without affecting the quality of service of CBR/VBR connections. Second, the share of available capacity used by a single ABR connection is dynamic and varies between an agreed MCR and PCR.

Third, the network provides feedback to ABR sources so that ABR flows are limited to available capacity. The time delays inherent in providing feedback dictate the use of buffers along a connection's path. Because of the large data rate and a relatively large propagation



ABR is useful for on-line sessions where the network response is critical.

delay through a network, these buffers may be substantial, leading to large delays. Accordingly, the ABR service is appropriate for applications that can tolerate adjustments to their transmission rates and unpredictable cell delays. Finally, for ABR sources that adapt their transmission rate to the provided feedback, a low cell-loss ratio is guaranteed.

Feedback Mechanisms

The transmission rate of cells from a source through an ABR connection is characterized by four parameters. The current rate that the source is permitted to transmit cells at is called the allowed cell rate (ACR). The source transmits cells at any rate between zero and the ACR. The MCR is the minimum value the ACR may take. The network will not restrict a source's flow to less than the MCR. You can set the MCR to zero for a given connection. The PCR is the maximum rate the ACR may take. The initial cell rate (ICR) is the initial value assigned to the ACR.

A source starts with the ACR equal to the ICR and dynamically adjusts the ACR based on feedback from the network. Feedback appears periodically as a sequence of resource management (RM) cells. Each cell has three fields: a congestion indication (CI) bit, a no increase (NI) bit, and an explicit cell rate (ER) field. The source first checks the 2 feedback bits. If an increase is called for, it is increased by a fixed-size increment. If a decrease is called for, the rate is lowered by a fixed-size increment.

Finally, if the ER is smaller than the ACR, the source reduces the ACR to the ER. These adjustments are subject to the constraint that the ACR varies between the limits of the MCR and the PCR.

Cell Flow

The figure "Adjusting ATM Cell Flow" illustrates the way that the feedback works. It depicts a flow of data in one direction over an ATM connection; a similar flow occurs in the opposite sense for two-way data communication. Two types of ATM cells flow on an ABR connection: data cells and RM cells. A source receives a regular sequence of RM cells that enable it to adjust the rate of cell transmission.

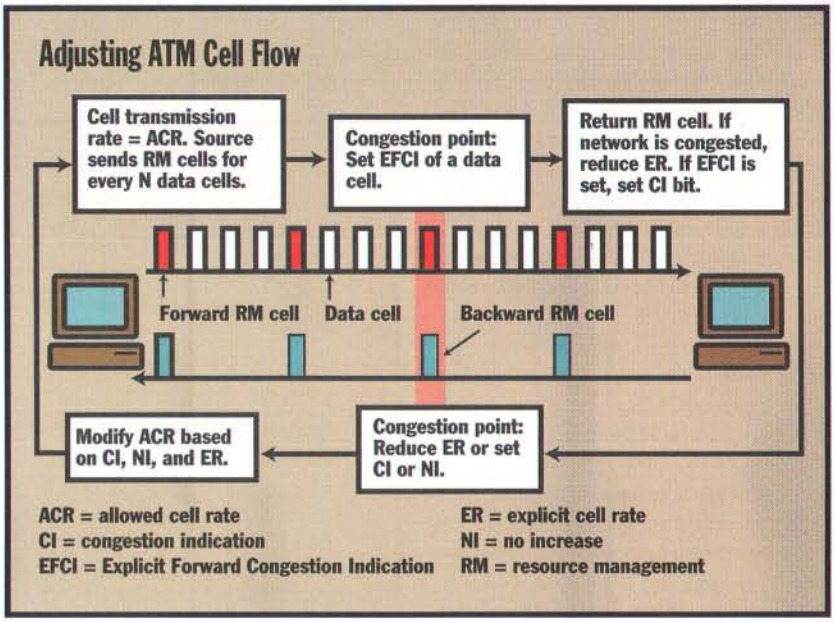
The source initiates the bulk of the RM cells. It transmits one forward RM (FRM) cell for every (Nrm – 1) data cells. Nrm is a preset parameter, usually equal to 32. As each FRM cell is received at the destination, it is turned around and transmitted back to the source as a backward RM (BRM) cell. Each FRM cell contains the CI, NI, and ER fields. The source typically sets CI = 0, NI = 0 or 1, and ER equal to a desired transmission rate in the range ICR ≤ ER ≤ PCR. An ATM switch or the destination system may change any of these fields before the corresponding BRM cell returns to the source.

An ATM switch on the network has a number of ways to provide rate-control feedback to a source:

- **EFCI marking:** The switch sets the Explicit Forward Congestion Indication (EFCI) condition in an ATM data cell header (using the payload type field) as it passes in the forward direction. This causes the destination end system to set the CI bit in a BRM cell.
- **Relative-rate marking:** The switch directly sets the CI or NI bit of a passing RM cell. If the bit is set in an FRM cell, that bit will remain set in the corresponding BRM cell. More rapid results are achieved by setting one of these bits in a passing BRM cell. To achieve the most rapid result, a switch may generate a BRM cell with the CI or NI bit set rather than wait for a passing BRM cell.
- **Explicit-rate marking:** The switch may reduce the value of the ER field of an FRM or BRM cell.

These actions let an ATM switch signal a source that congestion is occurring and to reduce its cell rate. The destination system can also signal congestion. Under normal conditions, a destination system simply converts each incoming FRM cell to a BRM cell without changing the NI, CI, or ER fields. The exception is that the CI bit gets set if an EFCI signal has been received on the previous data cell.

However, if the destination is experiencing congestion, it may set the CI or NI bit, or reduce the ER value when converting an FRM cell to a BRM cell. The first ATM switches to support ABR use the EFCI, NI, and CI bits, providing a simple relative-rate control mechanism. The more complex controls associated with the use of explicit rate constitute a second generation of ABR service. ■



The source adjusts its cell rate based on values returned by the destination and network switches.

William Stallings is a consultant on data communications and computer networking. This article is based on material in his latest book, High-Speed Networks: TCP/IP and ATM Design Principles *(Prentice-Hall, 1997). You can reach him at* **ws@shore.net.**

OS features and a freeware scripting utility solve application portability across various flavors of Unix. ***By Bob Friesenhahn***

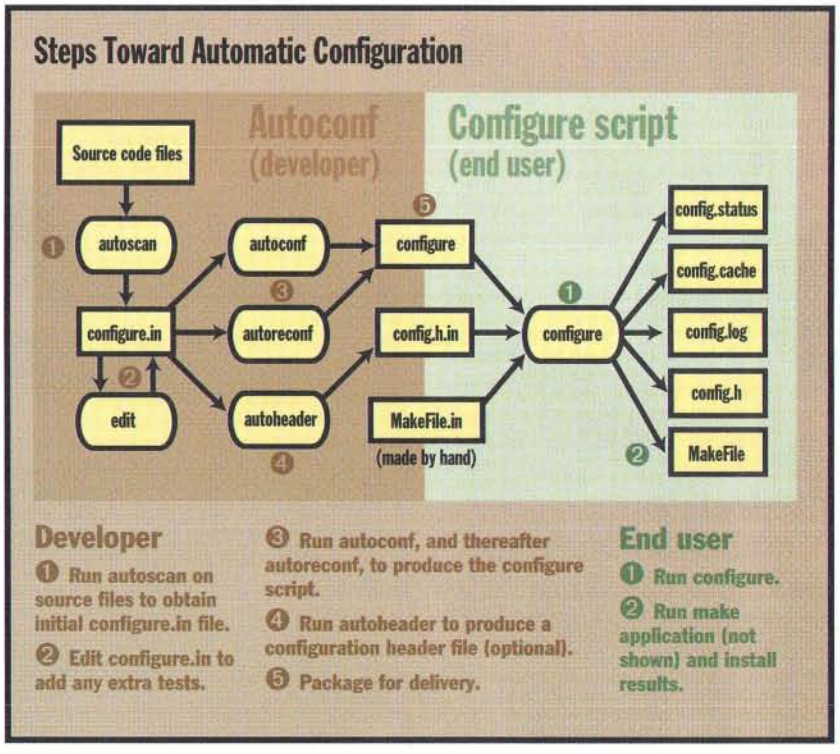
Autoconf Makes for Portable Software

Since the birth of Unix in 1969, there have been at least 70 distinct versions of Unix and Unix-like systems. With thousands of programmers enhancing Unix over the years for various system vendors and educational facilities, Unix's genealogy looks as tangled as a royal family tree.

Due to the many versions of Unix that exist, popular opinion is that portability among them is poor. To avoid a Tower of Babel situation, many vendors, users groups, and standards organizations have made efforts to define common components and APIs for Unix. The end result is that while all versions differ to some degree, in modern-day Unix systems the variance between the APIs for any two versions is small.

Still, if porting software is so difficult, why is there so much free software available for so many versions of Unix? During the first 20 years of Unix's history, software porting was something that often required overnight stints or even weeks of effort. Today, a utility called Autoconf neatly eliminates this work.

To understand how Autoconf does this magic, we must first understand the changes that have occurred to Unix over the years. In the early 1990s, two events made porting much easier: the use of feature-based portability and the invention of the configure script.



Autoconf lets programmers build scripts that tailor an application for a specific version of Unix.

Feature-Based Portability

Back when there were only a few Unix variants to contend with, it was common to base portability on preprocessor define statements that specified a particular version of Unix. Such statements as XENIX, BSD, SUN, USG, and SYSV were common. This is known as *OS-based portability*.

Unfortunately, as Unix continued to evolve, define statements that had previously made sense became incorrect. For example, when Sun went from using a BSD-based kernel to using an SVR4 kernel, software that made decisions based on the vendor's being Sun did not compile or work correctly on SVR4 implementations. By the mid-1980s, these problems became critical due to the ever-expanding pool of Unix variants and the growing amount of software that had to be maintained.

Feature-based portability then stepped in to the rescue. Rather than presuming certain characteristics based on an OS vendor, feature-based portability identifies the OS features (i.e., the APIs) that the software uses and compiles code conditionally based on those features. For example, the define statement HAVE_MADVISE is a feature-based definition rather than an OS-based one, since it identifies a capability found in any OS. Porting existing code to a new version of Unix entails identifying the features that the OS provides, providing equivalent definitions to the build system, and providing replacement code for features missing from the OS. After the code is ported to many systems, the various ways of solving a problem have been dealt with, and porting comes down to a simple configuration step and a build step.

The Configure Script

Configure scripts (usually written in the Bourne shell, /bin/sh) are designed to root

around in the OS and look for clues that tell it what features it has. The end result is a tailored make file, and possibly an include file or two.

The first significant configure script that I know of was written by Larry Wall and designed to configure Perl. This script was named Configure and became part of the Metaconfig package. Metaconfig Configure scripts are interactive and typically require the user to affirm guesses that it makes about the OS. The initial thrill of watching this script run is soon lost after the process continues for half an hour or longer.

However, David MacKenzie of the Free Software Foundation (FSF) wanted more: He wanted a configure script that didn't require any attention at all. This way it could be run simultaneously on many kinds of machines to aid in the FSF's porting and testing efforts. There was also the desire to automate the end user's software-installation process.

MacKenzie wrote the original versions of his configure script by hand, which made it difficult to reuse. He learned of similar efforts elsewhere at the FSF and at a company named Cygnus Support. Experience had shown that it was valuable to be able to build a configure script based on the needs of a specific program, rather than a monolithic one that supports all programs. The Autoconf package grew from a combination of all these ideas, and it became a common ground for configure-script efforts.

How Autoconf Works

Autoconf is based on a shell script wrapper around a macro language known as m4. This obscure macro language is similar in operation to the C preprocessor (cpp) but is much more powerful. Autoconf provides m4 macros that an application (or package) developer can use to

- determine installation paths
- locate tools and utilities
- determine compiler flags
- determine header-file availability
- determine available libraries
- test compilation of code fragments
- execute arbitrary shell-script fragments
- write make files
- write configuration-header files

The package developer informs Autoconf about features that the package requires by providing a file named `configure.in` as input. This file is an m4 script that invokes m4 macros provided by the Autoconf package. This creates a configure shell script that tests for OS features. When the generated configure script is executed, it takes template versions of files with the extension `.in` (e.g., `Makefile.in`) and edits them to generate a version tailored to the environment. (See the figure on page 45 for more on the files the developer makes and how they are deployed by an end user.)

The power of Autoconf is its ability to take advantage of the collective knowledge and experience of hundreds of software developers porting to the many variants of Unix. Each Autoconf m4 macro encapsulates this knowledge in a shell-script fragment that knows how to test for a particular feature. As Autoconf matures, developers using it automatically pick up portability improvements by simply upgrading to a newer version.

What You See

When you obtain a package that uses Autoconf, it will include (at a minimum) files named `configure`, `Makefile.in`, and, often, `config.h.in`. The configure script processes `Makefile.in` and `config.h.in` into `Makefile` and `config.h`, respectively. To configure and install the package in the `/opt/tools` directory tree, the end user executes these simple configure commands:

```
'configure--prefix=/opt/tools'
'make install'
```

This supports options that allow tailoring where files are installed. It also determines which features should be included in the package and where special-purpose libraries and files reside. See the listing above for a script example of this capability. If you ever happen to forget what these options are, just type `configure--help`.

Sample Autoconf Configure.in File

```
dnl Ensure that configure is run in correct directory.
AC_INIT(dos2u.c)

dnl Add code to deal with a configuration header file
AC_CONFIG_HEADER(config.h)
dnl Locate C compiler, 'install' and symbolic link utilities
AC_PROG_CC
AC_PROG_INSTALL
AC_PROG_LN_S
dnl Are the header files ANSI C compliant?
AC_HEADER_STDC
dnl Look for header files we know how to use.
AC_CHECK_HEADERS(fcntl.h string.h sys/types.h unistd.h)
dnl Checks for typedefs, structures, and compiler
    characteristics.
AC_C_CONST
AC_TYPE_OFF_T
dnl Checks for library functions.
AC_FUNC_MMAP
AC_CHECK_FUNCS(madvise mktemp)
dnl Create 'Makefile' from 'Makefile.in' template
AC_OUTPUT(Makefile)
```

Autoconf's Future

Most public-domain software packages now use Autoconf. With its ground swell of support, the future of Autoconf looks bright. Commercial software developers should note that Autoconf decreases the cost of, and increases the reliability of, supporting more OS versions. Software vendors can increase their profit margins and market share by using Autoconf.

As Autoconf continues to be refined, the winners will the users of Autoconf; the losers will be those who don't realize the value of this free software. B

Bob Friesenhahn (Dallas, TX) specializes in Unix- and TCP/IP-networking-related topics. You can contact him by sending e-mail to **bfriesen@simple.dallas.tx.us.**

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A standard for database objects lets disparate data-manipulation tools exchange information. ***By Stephen R. Gardner***

The Quest to Standardize Metadata

Metadata is popularly defined as "data about data." For the IT manager, this is more concisely stated as "information about the enterprise." In the context of data warehousing, the term refers to anything that defines a data-warehouse object, such as a table, query, report, business rule, or transformation algorithm. Metadata management gives users greater control of corporate data by providing a map of the locations where that data is stored. It also supplies a blueprint that shows how one type of information is derived from another.

The current crop of data manipulation and management tools has resulted in IT products that all process metadata differently, with little consideration for sharing the information. This situation highlights the need for a metadata standard.

Efforts are under way by a consortium of companies to standardize metadata interchange among products from diverse vendors. Six companies—Arbor Software, Business Objects, Cognos, Evolutionary Technologies International, Platinum Technology, and Texas Instruments Software—formed the Metadata Council in July 1995.

The Council launched the Metadata Interchange Specification (MDIS) to address issues relating to the exchange, sharing, and management of metadata. The Council released version 1.0 of MDIS in June 1996. The standards document can be downloaded from http://www.he.net/~metadata/standards/toc.html.

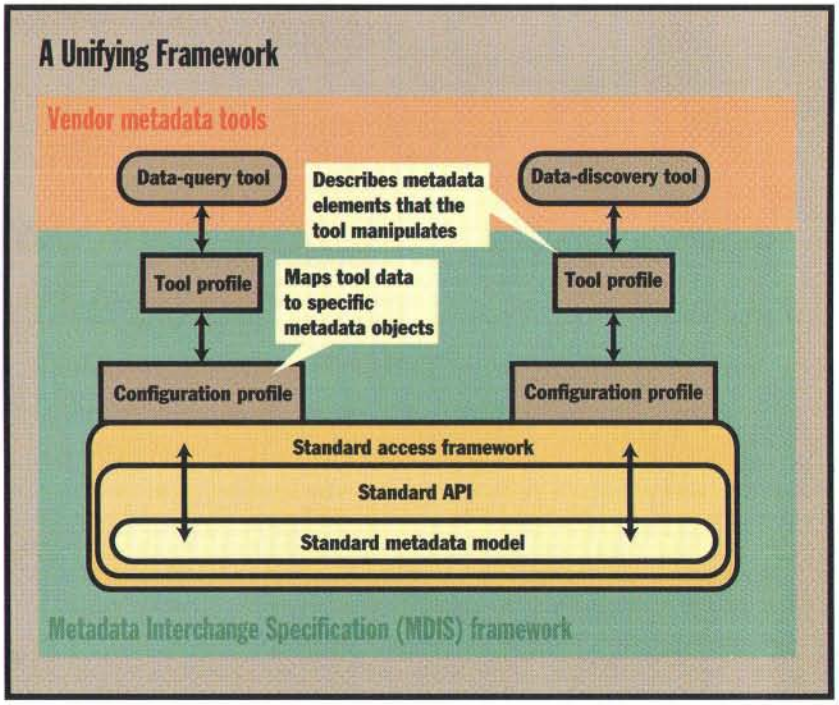
Initial Steps

MDIS consists of components that represent the minimum common set of metadata elements and the minimum integration points that must be incorporated into database tools for compliance. MDIS also provides standards for optional and extension components that are relevant only to a particular class of tool.

A common language must be developed before a standard can be constructed. This involves setting up well-understood and well-communicated processes for naming metadata elements, standardizing data types and lengths, and maintaining descriptive glossaries.

This development of a common definition and terminology involves two entirely different information models. First, there's the *application metamodel*. This model is application-specific and describes the tables and objects that contain the metadata for schemata particular to a given application. Second is the *metadata metamodel*, which is the set of objects that MDIS describes. These objects reflect information common to one or more classes of tools, such as database servers and data-discovery and data-extraction tools. For MDIS to succeed, the metadata metamodel must be independent of any application metamodel. It must have a unique definition for each object, and it should be character-based so that it's platform independent.

Since metadata is stored in different types of storage or data formats—such as relational tables, ASCII files, and customized repositories—the MDIS access methodology must be very flexible. This requires a framework that translates a tool's metamodel access request to match the MDIS syntax and format, as shown in the figure above. *continued*



Profile information, an API, and a standard set of objects allow diverse metadata tools to interoperate.

To establish a bidirectional data flow, the standard uses three types of information. First, the metadata files include a header with version information. Second, a Tool Profile file contains character-based information that describes the type of metadata elements that the tool manipulates. Finally, a character-based Configuration Profile file describes the mapping of data to specific metadata objects. It also describes what flows of the metadata are legitimate: A tool might be prohibited from using a later version of a metadata object because of major changes to source-to-target mappings of the metadata.

MDIS uses a text-based tag language that resembles HTML. The mechanism that implements extensibility to the MDIS is similar to Lisp's properties object, a character field of arbitrary length that's composed of identifiers and a value. The tool's import function uses the identifier to recognize the metadata type and to locate the data within in the field. The value is the metadata itself.

In Search of a Standard

The Metadata Council examined several ways to implement the standardized MDIS model, as shown in the figure at right. The *ASCII batch approach* relies on an ASCII file format. The file contains descriptions of the common metadata components and standardized access requirements that make up the MDIS model. The file loads whenever a tool accesses metadata via the common API.

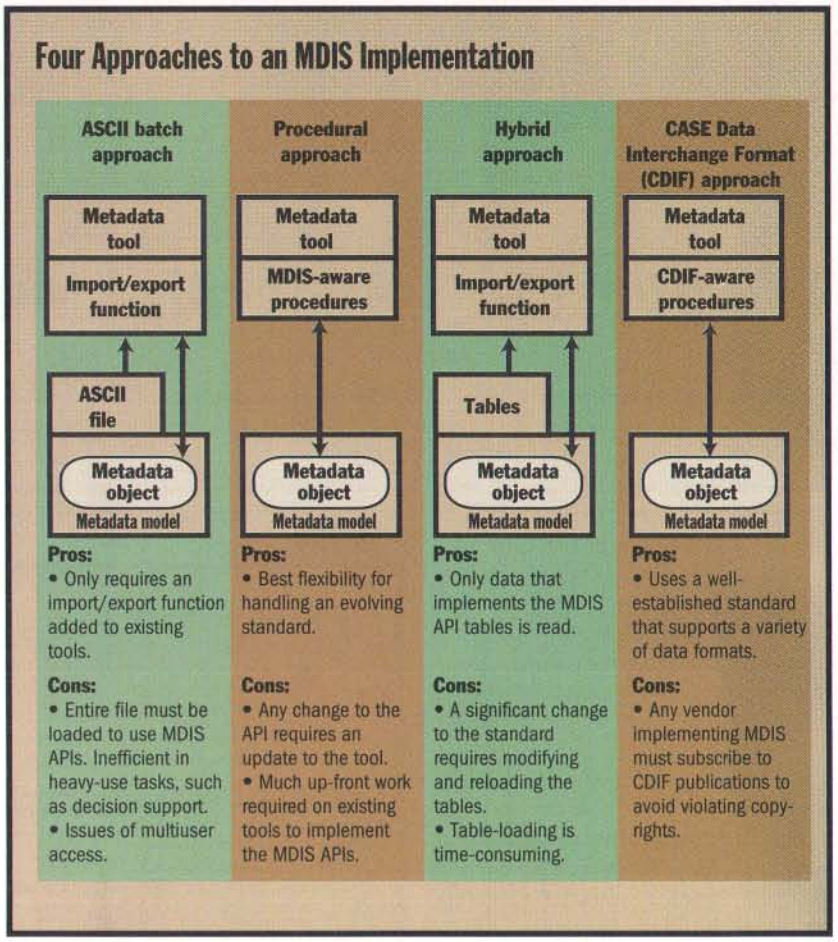
This approach does not require updating the tool when the metadata model changes; modifications to the standard are made to the file instead. However, since using an object requires loading the entire MDIS framework, this approach is processor intensive.

The *procedural approach* requires that the intelligence to communicate with the MDIS standard be built into the tool. This approach needs only a modification to the API to accommodate changes and additions to the metamodel schema and/or access parameters. But it also requires a great deal of up-front effort on the part of tool vendors to retrofit this logic to achieve MDIS compliance.

The *hybrid approach* combines the ASCII-batch and procedural approaches. It follows a data-driven model. A tool loads a set of tables that define the MDIS API. The tool interacts with the API through the MDIS framework and retrieves just the needed object. This eliminates the need for reading the entire schema.

Changes to the standard are reflected in the table data so that the tools don't have to be modified to maintain compliance with the MDIS specification. But loading the tables can be time consuming, which is unacceptable in information-intensive applications.

A fourth approach is to develop the MDIS standard within the Electronics Industries Association's CASE (Computer Aided Software and Systems Engineering) Data Interchange Format (CDIF). The CDIF standards support multiple semantic layers and transfer formats for CASE tools. Adopting this approach carries two obligations: the Metadata Coalition must appoint people to track the CDIF standards, and every vendor supporting the MDIS must subscribe to the CDIF publications to avoid violating the EIA's copyright on the standard.



The Metadata Council chose the ASCII batch approach because it's easy to implement and offers a shorter time to market.

For version 1.0 of the MDIS, the Council recommends the ASCII batch approach because vendors can implement support for the specification with minimum overhead and a shorter time to market.

Into the Future

There will continue to be a lack of integration among metadata tools for the next several years. Integrated metadata won't be readily available until at least the 1998/1999 time frame, when repository-based solutions should begin to emerge.

Furthermore, integrating new objects that consist of video, audio, and spatial data types will offer some additional challenges to the Metadata Council—as well as anyone who's looking for integration of metadata tools. B

Stephen R. Gardner (Seattle, WA) is the director of advanced technology research at NCR Corp. You can reach him by sending e-mail to **stephen.gardner@sanfranciscoca.ncr.co.**

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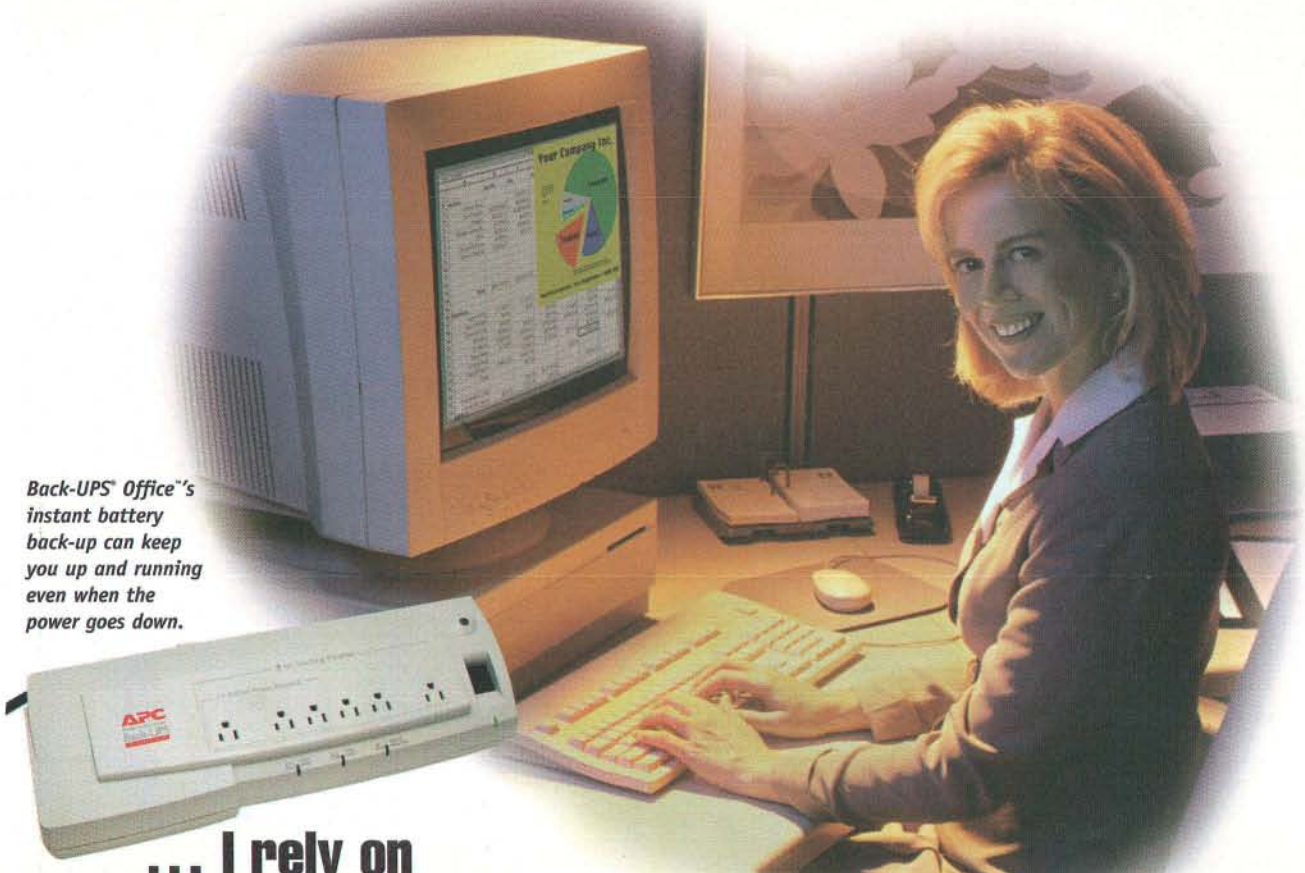

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A software emulator shows that the PowerPC can emulate another computer, down to its very hardware. ***By Eric Traut***

Building the Virtual PC

Development of Virtual PC—Connectix Corporation's Macintosh application that emulates a PC and its peripherals—began almost two years ago, in October 1995. The goal from the beginning was to create a fully Intel-compatible PC in software. The effort centered around a core Pentium instruction-set emulator, complete with MMX instructions. True PC emulation also required the reverse-engineering and development of a dozen other PC motherboard devices, including modern peripherals such as an accelerated SVGA card, an Ethernet controller, a Sound Blaster Pro sound card, IDE/ATAPI controller, and PCI bridge interface. This strategy of hardware-level emulation resulted in an application that allows Macintosh users to run not only Windows programs and DOS games but several x86-based OSes, including Windows 95, NT, and NeXT OpenStep.

Pentium Emulation

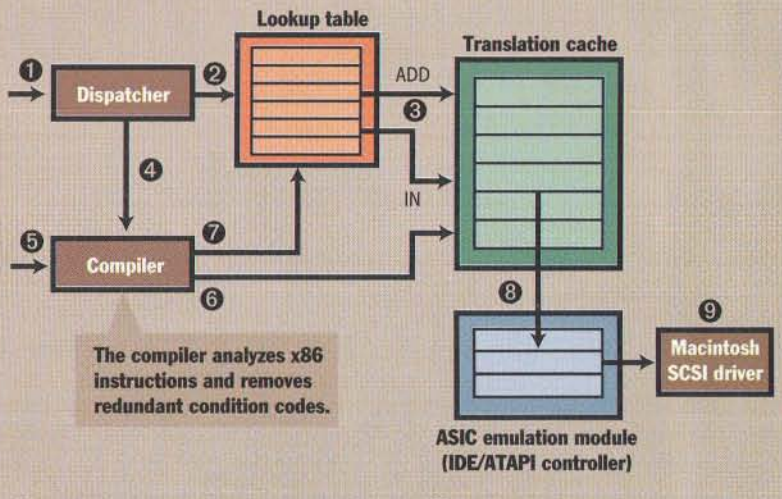
The heart of Virtual PC is the Pentium recompiling emulator, a sophisticated piece of software written entirely in hand-coded PowerPC assembly language. Its job is to translate Pentium instruction sequences into a set of optimized PowerPC instructions that perform the same operation. Translation occurs on a "basic-block" basis, where a basic block consists of a sequence of decoded x86 instructions. Basic blocks end on an instruction that abruptly changes the flow of execution (typically a jump, call, or return-from-subroutine instruction). As the recompiler decodes x86 instructions, it analyzes them for "condition code" usage. Finally, it generates a block of PowerPC code that accomplishes the same task. For more details on this process, see "Virtual PC Operation" at right.

For purposes of speeding things up, the emulator employs the following tricks.

Translation cache: Even though written in PowerPC assembly language, the translator still requires substantial time to generate optimized instruction translations. To reduce this overhead, the emulator caches blocks of translated code.

Interinstruction optimization: Because the Pentium is a CISC processor, most instructions perform more than one operation. For example, the ADD instruction not only adds two values together, it also produces a number of condition-code flags that tell programs whether the addition produced a zero or negative result. Such codes are used, for example, to determine if a program performs a conditional jump. Most of the time these codes are ignored. The translator analyzes blocks of x86 instructions to determine which flags the program uses (if any). It then generates PowerPC code for those flags actually used. The first two listings in "Translated Code" (next page) show how one Pentium instruction translates into three PowerPC instructions,

Virtual PC Operation



❶ Dispatcher reads address of Pentium's instruction pointer (IP).

❷ Dispatcher checks in a lookup table to see if PowerPC code already exists for the sequence of x86 instructions (basic block).

❸ If a compiled code block exists, execution jumps to the PowerPC code block in the cache.

❹ If a code block doesn't exist, the dispatcher invokes the compiler.

❺ The compiler reads x86 instructions until it hits an opcode that ends the block.

❻ The compiler stores the compiled block in the translation cache.

❼ The compiler stores the Pentium IP and address of the cached code block in the table.

❽ For an I/O instruction, a module that emulates the desired ASIC (based on the I/O port address) is called.

❾ Methods in the module either return values or generate equivalent Mac OS driver calls.

while three Pentium instructions can be optimized from nine into five PowerPC instructions.

Address translation: One of the most difficult Pentium features to emulate is its built-in memory management unit (MMU). This hardware translates linear (or logical) addresses into physical memory addresses. Operating systems use the MMU to implement virtual memory and memory protection. Because of the Pentium's small register file, about three in four Pentium instructions reference memory in one way or another. Each memory address potentially needs to be translated before the emulator loads from, or stores to, the referenced address. An MMU implemented in software would impose a high overhead, which would degrade performance. Luckily, this overhead can be avoided: The Connectix engineers were able to program the PowerPC's MMU to mimic the Pentium MMU's behavior, thus managing the address translations in hardware. The Pentium's memory page attributes can also be mirrored in the PowerPC's MMU. For example, if Virtual PC's emulated OS marks a memory page as write-protected, the page mappings are modified so the corresponding PowerPC page is write-protected.

Segment bounds checking: The Pentium architecture includes the archaic notion of memory segments. Every memory reference, such as instruction fetches, stack operations, loads, and stores, has an associated memory segment. When a segment's bounds are exceeded, the Pentium's MMU generates a general protection fault (GPF). The OS uses GPFs for more than detecting bugs in applications: They enable a program to "thunk" down into privileged driver-level code not accessible at the application level. Therefore, the Pentium emulator must detect segment bound faults where appropriate. Although the PowerPC does not contain segmentation hardware akin to the Pentium, Connectix used PowerPC `trap` instructions to perform segment bounds checks with little or no overhead.

Hardware Emulation

Besides the Pentium processor, a typical PC motherboard contains a dozen or so chips that work together concurrently. All these chips need to be emulated faithfully for compatibility. The Intel architecture provides an I/O address space that's used to access hardware outside of the CPU. You work with this "I/O space" through two instructions—`IN` and `OUT`. When using these instructions, software must specify an I/O port (or address). Virtual PC routes I/O accesses to code modules that emulate each chip. For example, if Virtual PC encounters an `IN` instruction referencing port 0x21, it calls a routine in the interrupt-controller emulation module that returns the current interrupt mask. Similar module calls occur for every I/O space access, as the third listing in "Translated Code" shows.

Many of the extra chips on a PC motherboard control I/O devices such as the hard drive, CD-ROM, keyboard, and mouse. For compatibility with the Mac OS and all Macintosh hardware, Virtual PC performs all I/O through the standard Mac OS drivers. So, a request sent to the emulated PC's IDE controller to read a sector from the hard drive gets translated into a read operation that's sent to the Mac OS SCSI driver.

The most difficult hardware components to emulate involve precise timing. For example, sound is a real-time operation, and any timing perturbation results in clicks or pops as digitally sampled data fails to arrive on time. Because Virtual PC is hosted on the Mac OS (which gives time to other Mac programs running concurrently, as well as Virtual PC), and it needs to emulate several dozen PC chips in parallel, precise timing isn't always possible. Virtual PC compensates by placing the highest priority on tasks that directly affect the user, such as sound and video.

Translated Code

Translation of Single Pentium Instruction

Pentium instruction	PowerPC instructions	
ADD EAX,20	li	rTemp1,20
	addco.	PF,rTemp1,rEAX
	mr	rEAX,rPF

Translation of Pentium Instruction Block

Pentium instructions	PowerPC instructions	
ADD EAX,20	add	rEAX,rEAX,20
ADD EBX,30	add	rEBX,rEBX,30
ADD ECX,40	li	rTemp1,40
	addco.	rPF,rTemp1,rECX
	mr	rECX,rPF

Code Translation for Pentium I/O Instructions

Pentium instructions	PowerPC instructions	
MOV AL,8	li	rAL,8
MOV DX,0x1F0	li	rDX,0x1F0
OUT DX,AL	bl	HandleIDEPortWrite
ADD DX,7	addi	rDX,rDX,7
IN AL,DX	bl	HandleIDEPortRead
RET	addi	rIP,rIP,8
	b	DispatchToNextBlock

Performance

Emulated systems are naturally going to be slower than real hardware. But Connectix engineers concentrated on tuning aspects of the emulated hardware required to run popular PC games and productivity applications at a usable performance level. This was especially challenging given that the PowerPC processor emulates not only the Pentium but all the other chips on a PC motherboard.

Performance of Virtual PC is also greatly affected by the host hardware system. The latest PowerPC processors with high clock rates and large on-chip caches will run it best. The speed and size of the system's L2 cache is also critical because of the code expansion that occurs during the translation process.

While users will take a performance hit because this is an emulator, Virtual PC successfully emulates the entire PC at a very low level. PC programs—applications, device drivers, and operating systems alike—cannot tell they are not running on actual PC hardware. B

*Eric Traut (**traut@connectix.com**) is lead engineer for Virtual PC at Connectix. At Apple Computer, he wrote the 680x0 dynamic recompiling emulator for PowerPC-based Macs.*

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DHTML supports dynamic objects and provides faster browsing through client-side processing. ***By Rick Dobson***

Dynamic HTML Explained, Part 1

Dynamic HTML (DHTML) is like HTML on steroids. It uses an object-based model that builds on HTML tags, yet it permits dynamic styles, content, and positioning as well as data binding to a browser. For the site visitor, DHTML Web pages deliver a richer, faster browsing experience through the magic of client-side processing.

This is the first in a three-part series on DHTML. A review of Cascading Style Sheets (CSS), a core DHTML enabling technology, leads into a discussion of HTML tags as objects. This DHTML primer closes with an introduction to the event object and *bubbling*—a new concept for scripting that simplifies and streamlines code.

Not surprisingly, Netscape and Microsoft offer different DHTML implementations. Both companies promise that these versions will converge after the World Wide Web Consortium (W3C) issues final recommendations. This article uses Microsoft's version because it offers more capabilities (for more information, see "Dynamic HTML Comparisons," September BYTE, page 23). It offers more than 90 HTML elements with properties, methods, and events. For detailed documentation, visit http://www.microsoft.com/msdn/sdk/inetsdk/help/. The site also includes many code samples that can jump-start you on your way to learning this new technology.

Tags and Scripting Objects

DHTML relies on CSS. This technology appeared initially with Microsoft Internet Explorer 3 and is approved by the W3C. CSS allows developers unprecedented control over the appearance and positioning of content on Web pages. It generally helps Web content authors separate style from content. (Look, Ma, positioning without resorting to tables!)

CSS offers four ways for site builders to incorporate style components into a document. First, you can reference an external style sheet. Second, you can physically import an external style sheet. Third, your code can create and modify style rules with a pair of style tags located inside the current document. Fourth, you can place in-line style attributes within the tags on a document. There are over 60 style attributes for fine-tuning the appearance of your Web pages.

All the traditional HTML tags become DHTML objects. DHTML developers must write short VBScript or JavaScript programs that enable end-user interactivity by manipulating object methods and properties. A rich array of events offers a broad selection of options for triggering code that responds to user and Web actions.

Each DHTML tag has a corresponding scripting element. The P tag, for example, matches a P element (or scripting object). The P tag's read-only `parentElement` property returns the next object up the document hierarchy—the `Body` element, which is owned by the HTML BODY tag. The P tag's read/write `innerText` property lets developers dynamically read and replace the text within a P scripting object.

Two P methods specifically support dynamic content operations. First, the `InsertAdjacentHTML` method lets you insert new HTML into a P tag. Second, the `InsertAdjacentText` method helps to update a paragraph's content, but not its HTML code.

Code Gallery

A Classy Style Change

```
<HTML><HEAD><STYLE>
 .bigred {font-size:24pt;
  color:red}
 .littlegreen {font-size:10pt;
  color:green}
</STYLE>
<SCRIPT LANGUAGE="JavaScript">
function changeStyle() {
 document.all.tags("P").item(0)
  .className = "bigred";
 document.all.tags("P").item(1)
  .className = "littlegreen";}
</SCRIPT>
<BODY onclick="changeStyle()">
<P CLASS="littlegreen">Welcome!
<P>Click anywhere to
        accentuate Welcome!
</BODY></HTML>
```

A Stylistic Style Change

```
function changeStyle() {
document.all.tags("P").item(0).
        style.fontSize = "24pt";
document.all.tags("P").item(0).
        style.color = "red";
document.all.tags("P").item(1).
        style.fontSize = "10pt";
document.all.tags("P").item(1).
        style.color = "green";}
```

Dynamic Styles

Many developers will be attracted to DHTML by its ability to change style in response to user and system events. One easy way to achieve this is with the `className` property. This property applies to block elements, such as P, and it corresponds to the CLASS attribute. To change styles, simply set the `className` property to a new style rule.

To revise a property, your code must first reference the underlying object. The `all` collection often makes this easy. Use the `all` collection's tag property to

flag all similar elements in a document. Then, use the tag's item method to reference specific instances of an element in a document. Then, you set the instance's className property equal to the new style rule.

The Classy Style Change listing in "Code Gallery" (on the previous page) illustrates these principles. The HTML document contains two style rules and two paragraph blocks. The block containing Welcome! has its CLASS attribute set to the littlegreen style rule. The other paragraph uses the default style. Clicking anywhere in the document fires the Body's onclick event. This event launches the JavaScript changeStyle function. It uses the index numbers of 0 and 1 to reference the document's first and second paragraphs. The JavaScript sets the className properties of the first and second paragraphs to the bigred and littlegreen style rules, respectively.

The Stylistic Style Change code segment in "Code Gallery" illustrates a more granular technique for achieving the same result. This version of changeStyle sets specific properties of the style object for paragraph blocks. When you need finer-grained control than the className property permits, or when you want to make ad hoc changes, consider using style object properties.

Events and Bubbling

DHTML introduces a new event object that tracks the firing of events. Its properties permit identifying the element where the event occurred, the current state of the keyboard keys, the location of the mouse, and the state of the mouse buttons. For example, the onclick and onmouseover events capture end-user mouse behavior relative to HTML tags, and the Body's onload event fires immediately after the browser loads a document. You write the handlers that respond to these events. Event handlers can be written in European Computer Manufacturers Association (ECMA) JavaScript or Microsoft VBScript.

DHTML events can bubble up from lower to higher document hierarchy levels. This permits events for lower-level objects to bubble up and trigger event handlers for unrelated upper-level objects. Because of this potential, you must consider whether your code should explicitly turn off bubbling.

The "Bubbling Up" code segment (above) illustrates how to use the event object, and it reinforces basic scripting techniques. The document in this code segment includes a couple of H1 blocks and a P block. Within the P block is a B block. The P block has an event handler, setParaStyle, that captures the onclick event.

Clicking anywhere in the P block launches its onclick event handler. It starts by setting a variable, el, equal to the source element for the event. This will be either P or its embedded B block. If the tag's name is not P, then the code sets el equal to the tag's parent, thereby forcing el to P. Notice that the function uses the tagName property of the srcElement property of the event object to detect where in the paragraph a user clicked. The code uses the textDecoration property of el's style object to underline the whole paragraph, no matter where the user clicks on the line.

The final line in setParaStyle turns off event bubbling if the user clicks in the B block. This line selectively controls event bubbling, depending on where in the line a user clicks. Clicks anywhere on the line—except in the B block—permit the event object to bubble up the document hierarchy to the Body level and beyond. Body's event handler, setBodyStyle, then changes the color of the document's two H1 blocks.

The setBodyStyle function also demonstrates some interesting scripting techniques. First, it uses the innerText property of the srcElement object to echo back which document object caused the function to run. Second, it uses a for loop to iterate through the item indices for the H1 tag objects.

Bubbling Up

```
<HTML><HEAD><SCRIPT LANGUAGE="JavaScript">
function setParaStyle() {
  var el = window.event.srcElement;
  while (el.tagName != "P")
       {el = el.parentElement;}
  el.style.textDecoration = "underline";
  if (event.srcElement.tagName == "B")
       event.cancelBubble = true;}
function setBodyStyle() {
 alert ("Clicked heading is: "
   + event.srcElement.innerText)
  var coll = document.all.tags("H1");
  for (i=0; i<coll.length; i++)
    coll.item(i).style.color = "green";}
</SCRIPT></HEAD>
<BODY onclick="setBodyStyle()">
<H1>First Welcome!</H1>
<H1>Second Welcome!</H1>
<P onclick="setParaStyle()">Click anywhere,
 <B>but here</B>, to bubble up.
</BODY></HTML>
```

Hard Choices

DHTML offers Web developers the potential of improved speed and interactivity; it offers Web users a richer browsing experience. The technical challenge of moving to DHTML calls out to HTML and Visual Basic developers because it builds directly on HTML but offers an object-oriented model that is familiar to VB programmers.

The operational challenge of moving to DHTML might be more problematic. Will folks be able to view the effects? The answer is "Yes" only if they have the Internet Explorer 4 browser. There are two solutions to this predicament. First, target DHTML for environments where you can mandate the browser (an intranet or extranet). Second, make your Net applications so compelling that folks voluntarily upgrade to the free Microsoft Internet Explorer browser. B

Rick Dobson, Ph.D., is president of CAB, Inc., a database and Internet development consultancy. You can reach him by sending e-mail to **Rick_Dobson@msn.com.**

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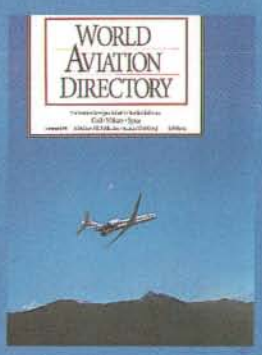

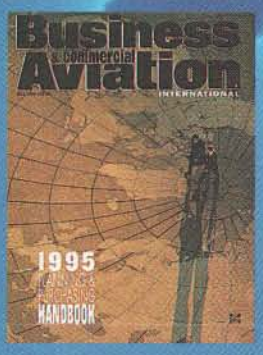

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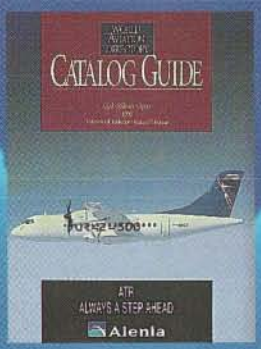

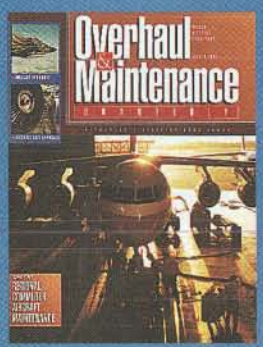

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THE ORBITING INTERNET

Fiber IN THE Sky

Broadband satellite systems stand ready to bring multimegabit data rates worldwide. Sounds great. What's the catch?

By John Montgomery

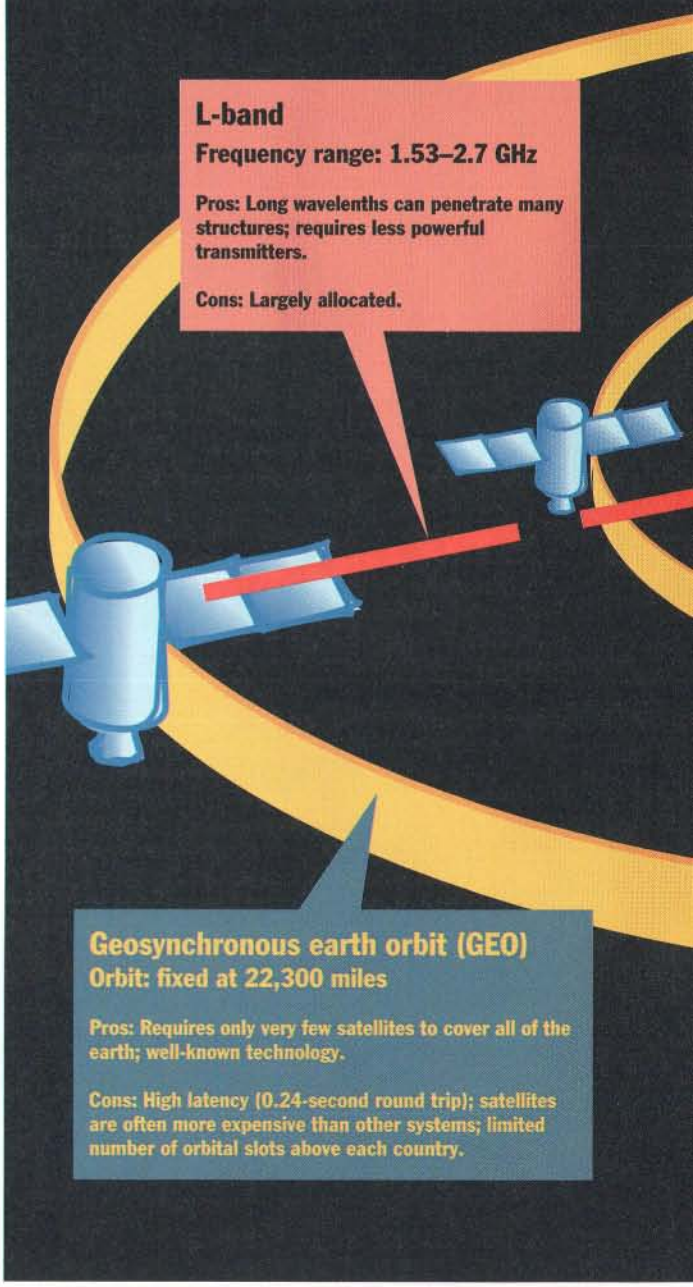
Something special is in the air: your data. Or, at least, it's about to be. The technological and regulatory hurdles to create true high-speed satellite networks have fallen. We've seen low- and mid-bandwidth systems such as Motorola's Iridium and Hughes' DirecPC. But those were almost a parlor trick compared to the promise of 2 Mbps, 20 Mbps, and even 155 Mbps streaming down from the sky. And all you need is a small antenna, a satellite-to-computer gateway (a small black box), and the service itself. In all, you'll probably buy satellite service pretty much the way you buy Internet service from an Internet service provider (ISP) today.

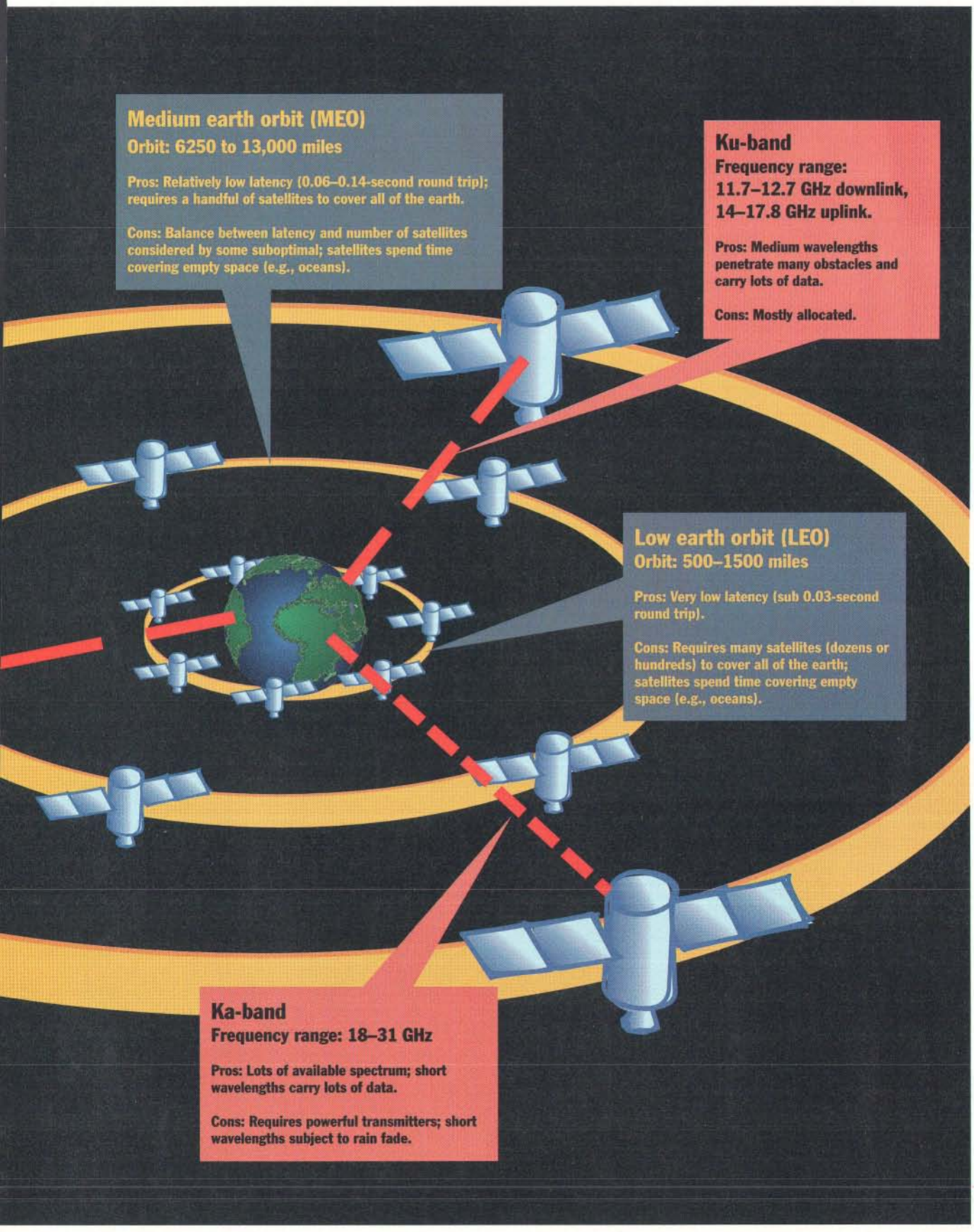
So, it's time to ditch your T1 lines and asynchronous transfer mode (ATM) hardware, right? Not quite yet. Just as Iridium's universal telephone didn't kill the cellular phone, broadband satellite systems won't kill terrestrial lines. Every broadband satellite system creator I talked to was clear that broadband satellite systems will complement terrestrial networks. They will provide high-speed service where terrestrial infrastructure does not exist, and they will enable easy multipoint distribution of video. But high-speed, low-cost landlines are here to stay.

So where *will* these emerging data networks fit in? Better yet, *how* will they fit in? What makes them different from each other? Simple questions, it seems. The answers are also simple—at least until you start to dig. By examining some of the main systems in development, I was able to determine that these systems, while touting much the same capabilities, are vastly different. Some of the most visible ones may prove the most difficult to implement. Some of the most staid-looking

The Air Up There

The two primary considerations with any satellite system are how far from the earth it is (its orbit), which affects latency, and the spectrum it uses, which affects how powerful the signal needs to be and how much data it can carry.




Medium earth orbit (MEO)
Orbit: 6250 to 13,000 miles
Pros: Relatively low latency (0.06–0.14-second round trip); requires a handful of satellites to cover all of the earth.
Cons: Balance between latency and number of satellites considered by some suboptimal; satellites spend time covering empty space (e.g., oceans).
Ku-band
Frequency range: 11.7–12.7 GHz downlink, 14–17.8 GHz uplink.
Pros: Medium wavelengths penetrate many obstacles and carry lots of data.
Cons: Mostly allocated.
Low earth orbit (LEO)
Orbit: 500–1500 miles
Pros: Very low latency (sub 0.03-second round trip).
Cons: Requires many satellites (dozens or hundreds) to cover all of the earth; satellites spend time covering empty space (e.g., oceans).
Ka-band
Frequency range: 18–31 GHz
Pros: Lots of available spectrum; short wavelengths carry lots of data.
Cons: Requires powerful transmitters; short wavelengths subject to rain fade.

systems may beat every other system to the punch.

Playing with the Bands

Satellite communications is nothing new. For years, you could hook up a very small aperture terminal (VSAT) system and buy time on a satellite. Dennis Conti, vice president of VSAT at Hughes Network Systems, says that a VSAT system can deliver up to 24 Mbps in a point-to-multipoint link (e.g., a multicast) and up to 1.5 Mbps in a point-to-point link. Pretty impressive statistics.

But, according to Tony Trujillo, director of corporate communications at Intelsat, a leading global satellite operator, with VSAT, "customers buy very specific time on a specific satellite." This creates a system that's good for predictable communications (e.g., periodic uplinks by news agencies or satellite offices), but not so good for the ad hoc networking that most of us are used to.

For "anytime, anywhere" networking, you need new technologies. Primary among them are more tightly focused beams and digital signal technology, which together can increase frequency reuse (and thereby increase bandwidth) and reduce dish size from meters to centimeters. According to some, you also need a large and unused chunk of the electromagnetic spectrum.

All these technical requirements began to come together in 1993, when NASA launched its Advanced Communication Technology Satellite, or ACTS (see the text box "NASA Gets into the ACTS" on page 61). ACTS pioneered the testing of an all-digital, Ka-band (20–30 GHz), spot-beam, geosynchronous earth orbit (GEO) satellite system—for definitions of these terms, see the text boxes "The Air Up There," "NASA Gets into the ACTS," and "I'm with the Band"—capable of delivering hundreds of megabits per second of bandwidth. With NASA showing that such a system could work (and offering time on the system to interested institutions), it was not long before others were interested. Very interested.

Earlier this year, the FCC granted orbital locations and Ka-band licenses to 13 companies. Some are names you may recognize: EchoStar, Hughes, Loral, and Motorola. Others may be more obscure: Ka-Star, NetSat 28, PanAmSat, and Teledesic. Regardless of name recognition, they all aim to bring information into your home and office at incredible speeds—up to 155 Mbps. These broadband systems are not going on-line before 2000 (although Loral's Cyberstar will start offering 400-Kbps rates next year), and most will not be fully operational until 2002.

What are they going to use it for? According to the FCC, just about everything you would use a terrestrial line for: desktop-to-desktop videoconferencing, Internet access, electronic messaging, faxing, telemedicine, direct-to-home video, electronic transaction processing, distance learning, and even news gathering.

Is This Trip Necessary?

Who needs this stuff, anyway? Most of the market that needs data services seems to be well served by landlines. "These systems will be important globally. In the U.S.? We're well served, although things are changing quickly," says Erwin Edelman of NASA's Lewis Research Center.

A first guess at an obvious market is in places that have underdeveloped communications infrastructures. In some countries, stringing copper or fiber is out of the question—the empty distances to cover are too great and available money is too little. (There are places where people will rip down any copper wire to resell it.) Still, a wireless, solar-powered telephone has some appeal. Of course, you don't need a broadband satellite to make phone calls, though. Systems such as Iridium will likely serve that market. Marco Caceres, of the Teal Group, says, "For most of the people in the world, the services Ka-band supplies aren't interesting."

So who *does* need this new class of broadband satellite communications? The first answer I heard from virtually every broadband vendor is the same: multinational corporations. "For some applications, landlines will always be superior. But when your reach is diverse and you have last- and first-mile problems, then satellite will be the better choice," says Edward Fitzpatrick, Hughes Communications'

Physics Is Everything

When it comes to communications satellites, what chunk of the radio spectrum they can use determines virtually everything—what they can do, how powerful they'll be, and how much they're going to cost. Why? Physics.

Let's start with the basics. You'll hear the terms frequency and wavelength bantered about quite a bit, so you have to know what they are. Remember that radio comes in waves; imagine a sine wave for simplicity's sake. How often a crest of a radio wave passes a point during a given time is called its frequency. Frequency is measured in hertz (Hz)—cycles per second—and its variations: kilohertz (kHz), megahertz (MHz), gigahertz (GHz), and so on. The distance between crests is the wavelength, and it is usually measured in some multiple or fraction of meters.

Radio frequency and wavelength are related—higher frequencies mean shorter wavelengths and vice versa. Why? If you know how many pulses are hitting you in a second and how far apart the crests are, you know the speed, right? Well, the speed is constant: Radio waves travel at the speed of light (i.e., 300,000 kilometers per second, or 187,500 miles per second, which is usually rounded to 186,000 miles per second). Therefore, if wavelength goes up, frequency has to go down and vice versa.

Different wavelengths have different properties. Long wavelengths can easily travel long distances and go through obstacles. Think of AM radio. At around 1 MHz, its waves are about 300 meters long. You can pick up AM stations much farther away than FM stations, which are up around 100 MHz, or 3 meters. These longer waves can pass through or around buildings and mountains. The shorter the wavelength (i.e., the higher the frequency), the more easily the waves can be stopped. When frequencies get high enough (up in the tens of gigahertz), small things such as leaves and even rain can stop them—a problem called "rain fade." It takes a lot of power to get around rain fade. More power means bigger transmitters or more focused antennas, which usually means satellites that are more expensive.

The flip side of this is that higher frequencies (i.e.,Ka- and Ku-bands) enable transmitters to transmit more information per second. That's because information is typically encoded at a certain part of the wave—the crest, valley, beginning, or end. (In the film *Crimson Tide*, Denzel Washington's character wanted to verify a signal using the extremely low frequency [ELF] antenna. Unfortunately, ELF transmission was so slow that they couldn't get a complete message before they had to start evading the bad guys.) The trade-off is that higher frequencies mean more information per second, but they require higher power to avoid getting blocked, larger antennas, and more expensive equipment.

Broadband Satellites, Broadly

	Cyberstar	Celestri	Astrolink	Teledesic	Spaceway	Skybridge
Backers	Loral	Motorola	Lockheed	Bill Gates, Craig McCaw, Boeing	GM-Hughes	Alcatel with Loral
Use	Data, video	Voice, data, video-conferencing	Data, video, rural telephony	Voice, data, video-conferencing	Data, multimedia	Voice, data, videoconferencing
Altitude (miles)	22,300	875 and 22,300	22,300	435	22,300	911
Spectrum	Ku (initial) and Ka	Ka and also 40–50 GHz	Ka	Ka	Ka	Ku
Antenna size (est.)	16 inches (initial Ku)	24 inches	33–47 inches	10 inches	As small as 26 inches	TBD
Data throughput	400 Kbps (initial Ku); up to 30 Mbps (Ka)	Up to 155 Mbps transmit and receive	Up to 9.6 Mbps	16 Kbps–64 Mbps (up to 2.048 Mbps on symmetrical links)	Up to 6 Mbps	16 Kbps–2 Mbps to satellite; 16 Kbps–60 Mbps to user; any multiple of this for business users
User terminal cost (est.)	$800 (initial Ku); $1000 (Ka)	Starts at $750	Under $1000 to $2500	N/A	Under $1000	$500 (consumer)
System cost (billions)	$1.05	$13	$4	$9	$3.5	$3.5
Operation starts	1998	2002	Late 2000	2002	2000	2001
Number of satellites	TBD for Ku; 3 likely for Ka	63 LEOs, 9 GEOs	9	288	8 initially	64
Access method	FDMA, TDMA	FDMA, TDMA	FDMA, TDMA	MF-TDMA, ATDM	FDMA, TDMA	CDMA, TDMA, FDMA, WDMA
Intersatellite communication	Undecided	Yes	Yes	Yes	Yes	No

NASA Gets into the ACTS

The whole Ka-band craze can be traced to NASA. When it launched its Advanced Communication Technology Satellite (ACTS) in September 1993, it began a research-and-testing project to determine what it needed to do to make Ka-band satellite communication work. "All the current Ka-band filings [to the ITU] are a direct tribute to ACTS technology," says Erwin Edelman, demonstrations coordinator at NASA's Lewis Research Center.

ACTS proved that it was possible to create an all-digital Ka-band system that could overcome rain fade, a signal-degradation problem resulting from short wavelengths passing through rain. ACTS is a TDMA-based system that uses many of the things you'll find in commercial Ka-band satellite systems, including spot-beam (or multibeam) technology, on-board storage and processing, and all-digital transmission.

Spot-beam. This technology enables an antenna system to subdivide a single large footprint (area of coverage) into many subfootprints. It can then focus these subfootprints (or spot beams) on particular areas. Subdivision enables a high degree of frequency reuse. Rather than spreading the entire frequency over the entire footprint, it spreads subsets of the frequency over smaller footprints. And, most important, it reuses these subsets in nonadjacent footprints.

On-board storage and processing. Most satellites are "bent pipes"—a signal goes up and then goes back down immediately. On-board storage and processing enables the caching of information until a spot beam is aimed; it also enables intersatellite switching.

All-digital transmission. To overcome rain fade, signals need to be digital so that they can incorporate error codes. According to Edelman, ACTS uses the same TDMA system that you'll find in terrestrial cellular systems.

Together, these technologies enable nearly unheard-of data rates. "The ACTS is theoretically capable of communicating over three 622-Mbps channels," says Edelman. In case you're wondering, that's about 400 T1 lines.

vice president for Spaceway.

Of course, there are even places in the U.S. that won't get broadband data service for a long time. For example, until recently, BYTE's office in Peterborough, New Hampshire, would have had serious problems getting anything more than a T1. But imagine if one of these satellite services had been in place—we could have tapped it no matter where we were. That is the second market that most of the broadband vendors cited—low-population areas.

The main problem satellite systems solve is getting high-bandwidth access to places without a high-bandwidth infrastructure. It's unlikely that a satellite system could compete with Digital Subscriber Line (DSL) to the home or fiber to the office—if you can get those services. Still, if you're in a rural area of the U.S.—or in a low-population area in any country—you may not be able to get such services. Satellites will deliver them, enabling not only high-speed Internet browsing (a technology that some industry pundits focus on relentlessly), but all forms of high-speed networking, including such things

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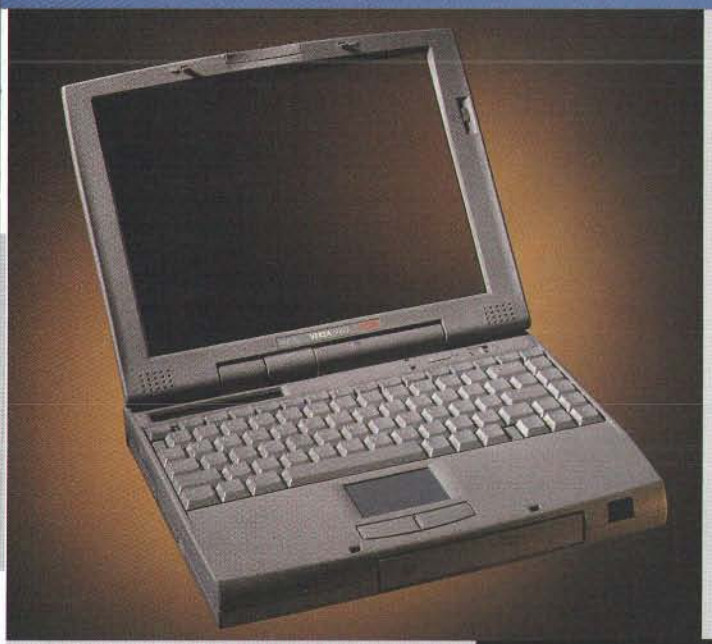

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Is the telephone dead? Says Teledesic president Russell Daggatt, "It's not going to replace the current phone network—the capacity isn't there." Put simply, terrestrial networks and satellite networks will complement each other. "Nobody's going to put up a satellite dish and take out their telephone," agrees Ron Maehl, president of Cyberstar. "We don't believe satellite should compete with fiber or Asymmetric Digital Subscriber Line (ADSL)—it should complement them, especially for bursty service. Use the technologies for what they're best suited."

LEO vs. GEO

But bandwidth is only half the story. The other half is latency—the amount of time for your data to get from point A to point B. Here is where the rubber starts to meet the road. It's all well and good to talk about high-bandwidth satellite systems—that technology has existed in VSATs for years. But to deliver on the promise of highly interactive satellite networks is a different matter altogether. "There are some applications not suitable to satellite," says Karl Savatiel, president of Astrolink and vice president for broadband systems at Lockheed. "Bond transactions, for example, are too latency-sensitive."

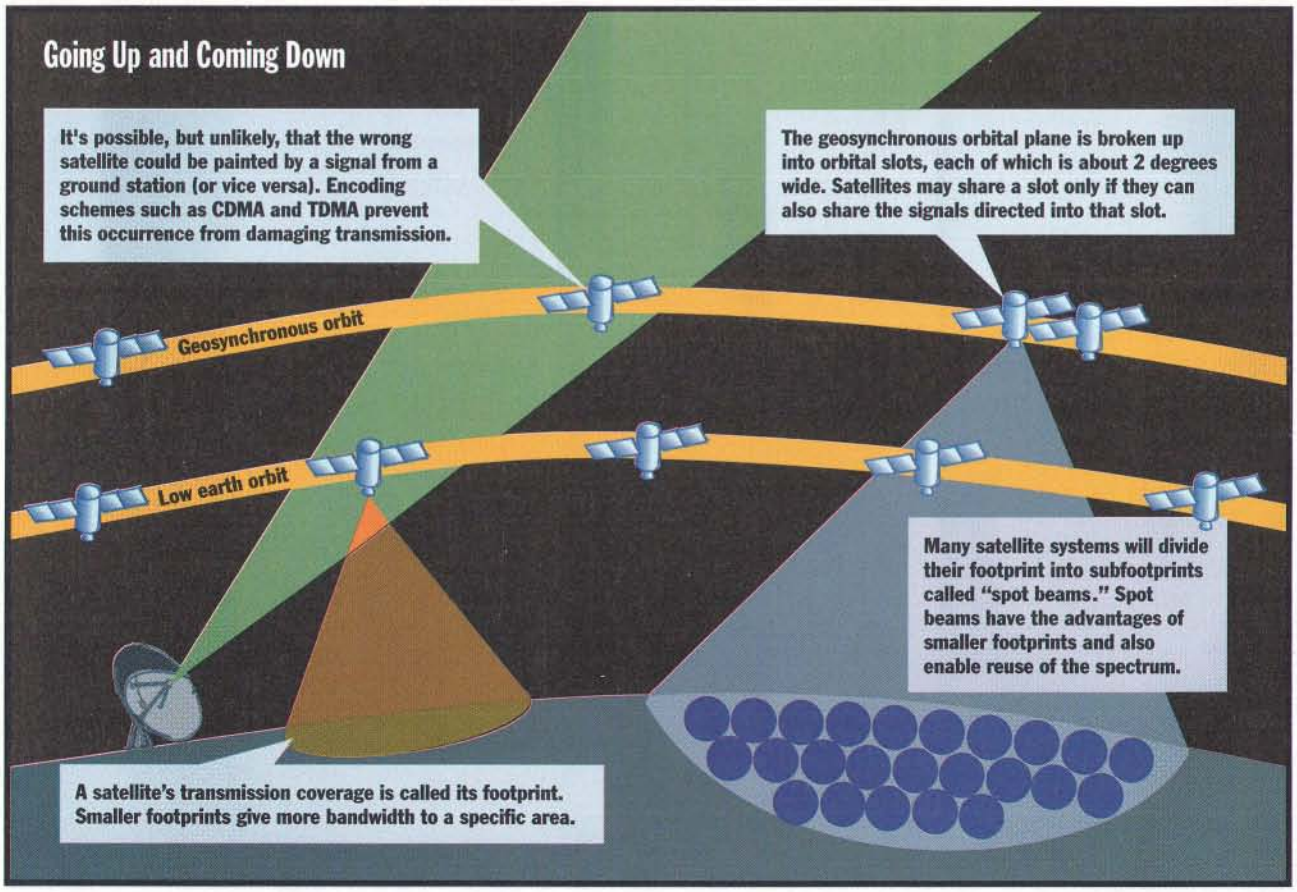
That is true—at least for a GEO system such as Astrolink. GEO satellites park some 22,300 miles above the equator: 0.24 second—an eon to computers—of round trip away. With that kind of latency built into the system (not counting whatever latency is added by the various gateways and translations the data must go through), a telephone conversation is an annoying, awkward mess. And any kind of interactive application has to be nonlatency-sensitive. So Bank of America can probably forget putting its on-line transaction processing (OLTP) system through a geostationary satellite. Such systems include not only Astrolink, but Loral's Cyberstar and Hughes' Spaceway projects.

So here's a simple solution: Move the satellites closer to earth. That's just what systems such as Teledesic, Alcatel's Skybridge, and Motorola's Celestri will do. With low earth orbits (LEOs) under 1000 miles, these systems offer latency that's barely apparent: hundredths of a second.

Of course, it's not that simple. While GEOs are a well-known technology (TV broadcasts, for example, have been using them for decades), LEOs are new and face new challenges. Perhaps the biggest one is that you need a lot of them to get total global coverage. At one point, Teledesic planned a constellation of more than 800 satellites, for example (that number recently dropped to 288 when it signed an agreement to work with Boeing). Until recently, the concept of launching dozens or hundreds of multimillion-dollar satellites was a pipe dream.

Each of Teledesic's 288 satellites will cost in the realm of $20 million, according to Daggatt. That's $5.76 billion just in satellites. That does not include launch fees or insurance—which, in the case of some satellite systems, is the price of the satellite again.

Price is only one issue. Who is going to launch all these satellites? Teledesic has set an 18-month to two-year launch window to get its 288 satellites airborne. All told, the LEO system creators are talking about putting more satellites into orbit in the next five years than the world has put into orbit since the Soviets launched Sputnik 40 years ago. To make it happen, a huge



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Some Satellite Personal Communications Systems

	Ellipso	Odyssey	ICO	GlobalStar	OrbComm	Iridium
Backers	Westinghouse, Harris, Israeli Aircraft Industries	TRW, TeleGlobe	Inmarsat, Hughes Space Telecom	Loral, Qualcomm, Alcatel, France, and many others	Orbital Sciences, Teleglobe, and many others	Motorola, Raytheon
Use	Voice, fax, messaging	Voice, fax, messaging	Voice and messaging	Voice, data, and fax	Messaging and tracking	Voice, paging, data, fax
Altitude (miles)	Elliptical: 325–4904; 5025	6471	6459	884	484	483
Spectrum request	UHF	L, S, and Ka	S and C	L, S, and C	VHF	L and Ka
Data throughput	0.3–9.6 Kbps	9.6 Kbps	2.4 Kbps	7.2 Kbps	56.7 Kbps	2.4 Kbps
User terminal cost (est.)	$1000	$300	Several hundred	$750	Starting at $500	$2500–$3000
System cost (billions)	$0.75	$1.8	$2.6	$2	$0.33	$3.7
Operations start	1998	2000	2000	1998	1995	1998
Number of satellites	17	15	12	56	36	72

jump in launch capacity is necessary.

Once the LEO satellites are in orbit, there's an entirely new set of problems. First, there's the matter of space junk: leftovers from past space missions of all sizes, speeds, and lethality. "With all these satellites in orbit, it's possible that debris will start running into them," says the Teal Group's Caceres. "They aren't that far from manned systems." Great—just what Mir needs.

More Problems for LEO

If the satellites don't get aced by space junk, they still will fall into the atmosphere eventually. Unlike GEOs that, when their operational life is over, move into a parking orbit a few miles higher than normal, LEO systems will burn up in the atmosphere, like SkyLab. Although satellite life may be 10 or 12 years, "with LEOs, you must have a plan for satellite replacement," says Myron Wagner, vice president and director of engineering for Motorola's Celestri system (a hybrid LEO/GEO system). It's possible, however, and Wagner cites Iridium as a pioneer in this field.

Let's say you solve these challenges. There are more. For example, there's the matter of acquiring and tracking these fast-moving satellites. A LEO satellite may be visible for only 20–30 minutes before it passes over the horizon. This poses no small feat for aiming the antenna and keeping the link active.

A technology called a phased-array antenna solves the antenna problem. Unlike a satellite dish, which mechanically tracks satellite locations, phased-array antennas are self-aiming boxes consisting of many smaller antennas. They can track several satellites using the slightly different signals received by the array of antennas—without physically moving, reducing wear and tear among other advantages.

The problem of keeping a link active when your satellite disappears every half hour is solved by keeping at least two satellites in view at all times (many LEOs will keep three or more in view). The antenna array is aware of all the satellites' positions and starts a new link before it severs the one to the setting satellite. This is "make before break" in satellite parlance.

All LEOs have to solve these challenges. Some of them have others, too. For example, there is the matter of whether a LEO constellation uses intersatellite routing. The problem is, how do you get a signal from the footprint of one satellite into the footprint of another? In other words, if a LEO user in New York wants to communicate with one in Moscow, the LEO system needs to figure out how to route the signal.

If the system is a bent pipe, such as Alcatel's Skybridge, the satellites don't have to be very smart. The LEO satellite over New York will beam the signal down to a ground station, which will route the signal over landlines to a ground station near Moscow. That station will feed the signal up to the LEO satellite over Moscow, which will in turn bounce it down to the user there.

According to Motorola's Wagner, however, "Bent pipes are not good. There are too many hops from sky to earth." And that means dreaded latency—defeating the whole reason LEOs are supposed to be better than GEOs. Instead, some systems, including Teledesic and Celestri, use satellite-to-satellite routing. The Teledesic constellation communicates in the 40–50-GHz band. Celestri uses lasers for its links.

The downside is, of course, that each satellite has to have more communications and tracking hardware—more intelligence—and therefore a higher price than a bent-pipe system. Also, the performance gain over a bent pipe is not tremendous—a few hundredths of a second.

Alcatel's Skybridge faces yet another set of challenges, because it selected the Ku-band instead of the Ka-band. According to Mark MacGann, director of public affairs for Skybridge, this lower frequency lets Skybridge be "the cheapest system in low earth orbit." That's because Skybridge can use less powerful transmitters. The Ku-band is pretty crowded, though, with many GEOs working there, and that spells interference when Skybridge satellites are over the equator. "We took the GEO arc," says MacGann, "and defined a nonoperating zone of a minimum of plus or minus 10 degrees. Once a Skybridge satellite comes

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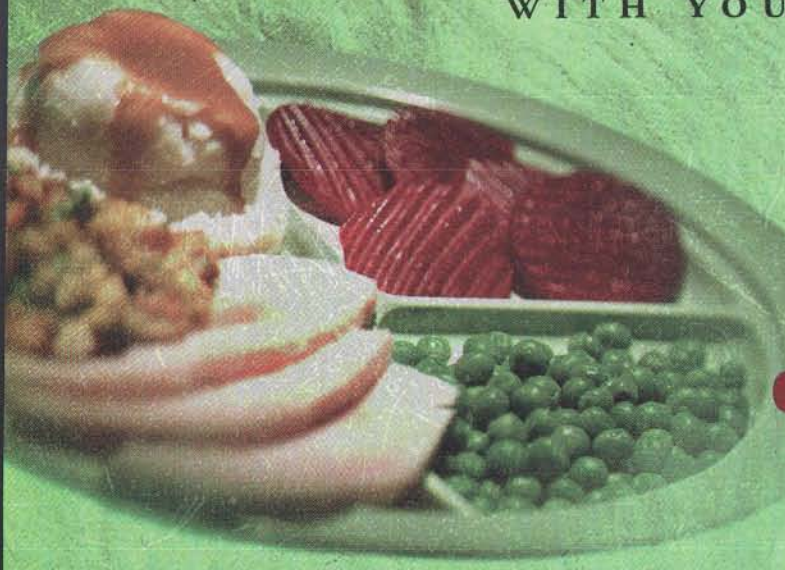

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Circle 149 on Inquiry Card (RESELLERS: 150).

within that arc, it shuts off its offending beams, and the ground terminal switches to another satellite." A simple solution.

Niches in the GEO Sphere

In spite of the concerns of latency, GEOs and LEOs will likely coexist. Guy Christensen, of Leslie Taylor and Associates, sums up the markets based on whether the system is a GEO, with its inherent 0.24-second delay, or a low-latency LEO. LEOs will be good for high-speed networking, teleconferencing, and telemedicine—interactive applications. GEOs will be better for information downloading and video distribution—broadcasting and multicasting.

Some GEO vendors disagree. Hughes' Conti says, "Today, we're able to use GEO satellites to transport at least 24 Mbps of broadcast IP data and over 2 Mbps of point-to-point TCP/IP data. The latter uses technologies such as TCP spoofing. HNS has been using this technique for over three years to deliver Internet/intranet content at high speed to both consumers and enterprises." If necessary, ground terminals using the Spaceway system will use similar TCP spoofing technologies.

But there's still the 0.24-second delay that you just can't get around. Daggatt says that any lossless protocol is going to have problems with this latency. Even if TCP spoofing works (and he is skeptical about that, given TCP's 64-Kb buffer), there's the matter of other protocols. "It's reasonable to think that future network protocols will be designed for terrestrial networks," he says. "You need systems that offer low error rates and low delay. People talk about voice and data as though there were two types of data. They aren't. And if the network doesn't work for voice, it won't work for other applications."

LEO Meets GEO

One of the systems I looked at is considering offering the best of both worlds: a hybrid solution. Motorola's Celestri plans a LEO constellation of 63 satellites (initially) coupled with one GEO satellite over the U.S. Motorola has the rights to eight more GEO orbital slots if it needs them. The LEO constellation and the GEO satellites will be able to communicate directly through a satellite-to-satellite network.

"We want users to be unaware of the kind of system they're using. The only way we know to do that is with a LEO configuration," says Wagner. The hybrid configuration will enable Celestri to take advantage of LEO's shorter delays for interactive uses and GEO's power in the broadcast arena.

Alcatel and Lockheed have had similar thoughts. They are looking at a partnership that will enable Skybridge and Cyberstar to work together through land-based gateways. It's not going to be quite as transparent as Celestri's system, because it will need to route traffic through terrestrial gateways, but it does hint at the power of a hybrid configuration.

Space Security Unit

Once you get beyond the latency and bandwidth issues (which is what the satellite creators spend a lot of time arguing over), there is another challenge: security. If your data is being packaged up and broadcast into space, can't anybody with a scanner just tune in? In theory, the answer is yes. But the access technologies that these systems use—combinations of code division multiple access (CDMA), time division multiple access (TDMA), frequency division multiple access (FDMA), and a bunch of other *x*DMA protocols—make that at least as difficult as it will be to intercept a digital cellular signal. On top of that, many of the networks will offer some kind of internal security systems. But exactly what kind? Well, that gets a bit murky.

All the vendors I spoke with told me that they were aware of the potential security

The Air Up There

One easy way to distinguish among the many new satellite systems is by how high up they are. This is also one key factor in determining how many satellites a system needs for worldwide coverage and how powerful those satellites must be. If an antenna can cover 15 degrees, for example, that same arc covers a much smaller area if the satellite is 200 miles away than if it's 20,000 miles away. However, it will require much less power to deliver a signal from 200 miles away than from 20,000 miles away. Satellite people have four basic terms to describe different altitudes.

GEO: Short for geosynchronous earth orbit, GEO satellites orbit at 22,238 miles above the earth's equator. At this altitude, the period of rotation of the satellite around the earth is exactly 24 hours. The satellite seems to stay above exactly the same point on the earth's surface. (As a footnote, this orbit is called a Clarke orbit, named for the author Arthur C. Clarke, who first posited in 1945 that it should be possible. According to BYTE senior contributing editor Jerry Pournelle, Clarke never got the patent he sought for figuring it out.) Most of today's satellites are GEOs, as are planned broadband systems such as Hughes' Spaceway and Loral's Cyberstar.

GEOs require few satellites to cover the entire earth's surface. However, they're saddled with a 0.24-second latency for a signal to travel from earth to satellite and back to earth again. GEOs also need to obtain specific orbital slots around the equator to keep far enough apart, each separated by 2 degrees, or about 1000 miles, according to Erwin Edelman, demonstrations coordinator at NASA's Lewis Research Center. The ITU and, in the U.S., the FCC mete out these slots.

MEO: According to Marco Caceres of the Teal Group, medium earth orbit satellites orbit at altitudes between 6250 and 12,500 miles. Unlike GEOs, their position changes relative to the earth's surface. At their lower altitudes, you need more of them to achieve complete coverage of the earth's surface, but the latency reduces substantially. Right now, according to Caceres, there aren't many MEOs, and the ones in orbit are used for positioning.

LEO: Low earth orbits promise extremely high bandwidth and low latency. Plans exist for huge constellations of hundreds of satellites that will cover the entire globe. LEOs generally orbit below 3125 miles. Most of them are much lower: only 400–1000 miles. At these altitudes, latency reduces to nearly negligible times–hundredths of a second.

Three kinds of LEOs handle different amounts of bandwidth. Little LEOs are low-bandwidth applications (tens to hundreds of Kbps) such as paging and include systems such as OrbComm. Big LEOs can handle paging, cellular services, and some data transmission (hundreds to thousands of Kbps). Examples include GlobalStar and Iridium. Broadband LEOs (sometimes called mega-LEOs) operate in the Mbps range and include Teledesic, Celestri, and Skybridge.

HALE: High-altitude, long-endurance platforms are basically a solar-powered, lightweight airplane or lighter-than-air craft that hover over an unmoving spot some 70,000 feet above the earth's surface. Not often talked about, and right now primarily a research venture. An example of a HALE that uses blimps is Skystation.

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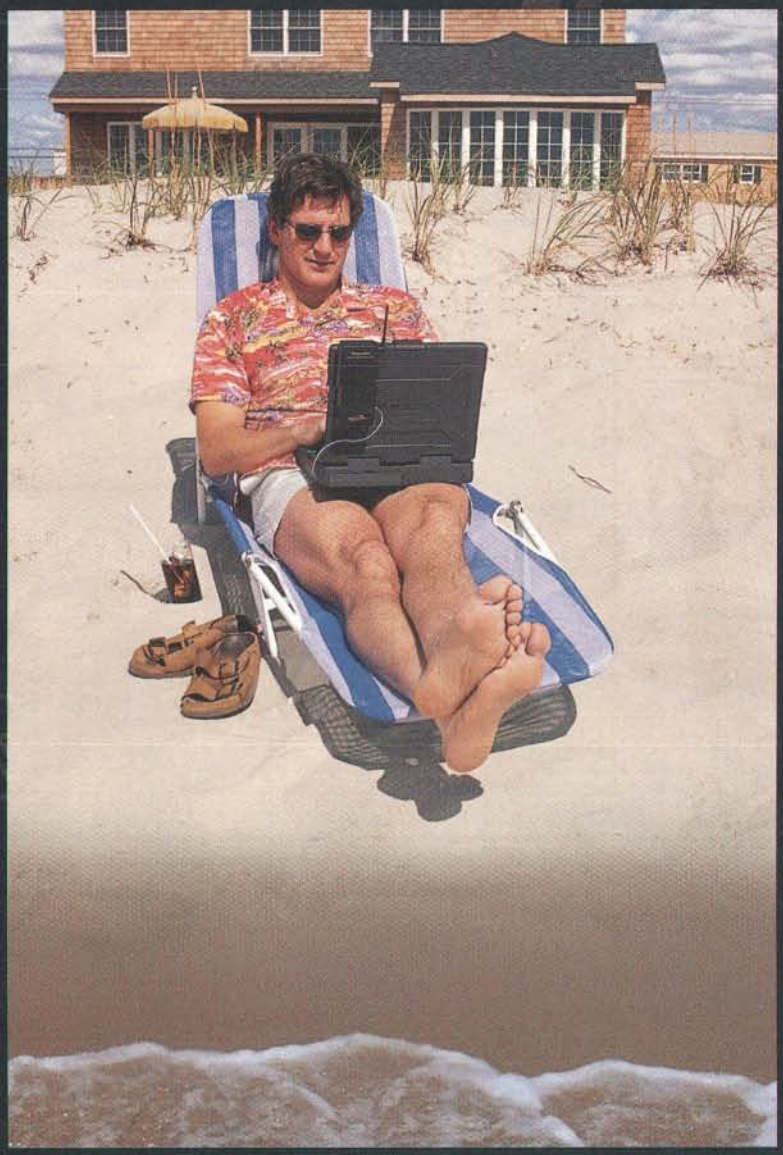

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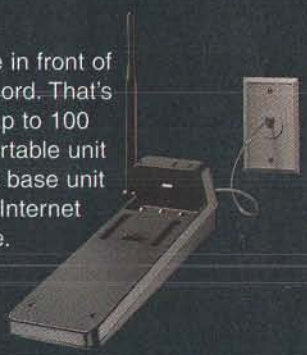

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concerns that customers would have. Few, however, had concrete solutions. Sig Dekany of Astrolink, for example, says, "I can say only that it does involve encryption. Additionally, second-tier security at the user level will come by way of public-key encryption." Representatives at Spaceway and Cyberstar were even less forthcoming, saying only that they were working on the problem and had not yet decided on a solution. Teledesic said that there is encryption within its network, and, if users want, they can add more. That seems to be the general consensus: If you want security, you're going to have to add it yourself.

But is that so different from running private business over any public network? Would you, for example, engage in trusted transactions over the Internet? Of course not. You would purchase some kind of encryption software, a virtual private network (VPN) system, for example. And because all the satellite systems claim that they will be completely transparent to your network, it's likely that the VPN system you purchase for the Internet will work just as well—and just as transparently—over a satellite system.

Down-to-Earth Price Tags

What will be the price for this magical universal service? Surprisingly, on a per-bit basis, every company I talked to said it will be probably not much more than what you're paying for your landline services. That may seem like a pretty amazing statement, considering the investment required to get some of these systems running—Teledesic, for example, is forecasting a $9 billion start-up charge (which some critics say is low); Motorola's Celestri is at $13 billion. But Teledesic president Daggatt thinks it's reasonable. "It's a very high-capacity system. And unlike a wire-line network, where all the capacity of the infrastructure is rigidly dedicated to locations and users regardless of whether they are actually using it at any particular moment, Teledesic offers 'bandwidth on demand,' where the system capacity used is limited to that required by a particular user and a particular application at a particular

What the Band Names Mean

Band Name	Frequency Range
HF-band	1.8–30 MHz
VHF-band	50–146 MHz
P-band	0.230–1.000 GHz
UHF-band	0.430–1.300 GHz
L-band	1.530–2.700 GHz
FCC's digital radio	2.310–2.360 GHz
S-band	2.700–3.500 GHz
C-band	Downlink: 3.700–4.200 GHz Uplink: 5.925–6.425 GHz
X-band	Downlink: 7.250–7.745 GHz Uplink: 7.900–8.395 GHz
Ku-band (Europe)	Downlink: FSS: 10.700–11.700 GHz DBS: 11.700–12.500 GHz Telecom: 12.500–12.750 GHz Uplink: FSS and Telecom: 14.000–14.800 GHz; DBS: 17.300–18.100 GHz
Ku-band (America)	Downlink: FSS: 11.700–12.200 GHz DBS: 12.200–12.700 GHz Uplink: FSS: 14.000–14.500 GHz DBS: 17.300–17.800 GHz
Ka-band	Roughly 18–31 GHz

I'm with the Band

The electromagnetic spectrum is an ongoing problem for everybody. To start off with, the common names for certain frequency ranges—or bands—date back to World War II. But worse, inconsistencies and anachronisms in the regulatory process may make it more difficult than necessary to get the bandwidth that a new system needs.

According to Ed Elizondo, systems engineering consultant at Lockheed, the IEEE has been pushing for a standard naming convention that would be easier to understand. Still, most people refer to segments of the radio spectrum by letter-band classifications that are often vague. In World War II, U.S. and British radar developers named parts of the spectrum with letters, such as L-band, C-band, Ku-band, and Ka-band (see the table "What the Band Names Mean"). The letters were chosen at random, so that the enemy wouldn't know what they were talking about. Over the years, some discrepancies crept into the labels, making some of the designations imprecise.

Many of the satellite system vendors cited the regulatory process as a problem. Skybridge's Mark MacGann puts it this way, "Spectrum is a scarce resource. The ITU has always allocated frequency on a first-come, first-served basis. But that cannot continue."

Indeed, the whole regulatory process could drive a neophyte nuts. According to Lockheed's Karl Savatiel, the process in the U.S. is highly iterative. You file with the FCC for authority to construct radio beacons at a particular frequency (and a position in the case of GEOs). If someone asks for the same frequency, the FCC makes its decision based on the greater public good. If there's a conflict, there may be an auction (which is what happened with the Ka-band when it opened up).

Then the FCC takes all the U.S. filers to the ITU—the international coordinating body. However, because the ITU allocates bandwidth on a first-come, first-served basis, while the FCC is resolving U.S. conflicts, other countries that can resolve conflicts quicker may be getting orbital slots and frequencies that U.S. companies were counting on.

Then it goes back to the FCC's drawing board. "The FCC has teeth in its process," says Savatiel. "If you don't deliver in five years, you lose your slot; the ITU has fewer teeth—you won't lose it for at least nine years."

Until recently, this arrangement hasn't been a problem. However, if future spectrum allocations are as heated as the Ka-band's, the ITU may need to reconsider its process to add more teeth—perhaps a "greater public good" system.

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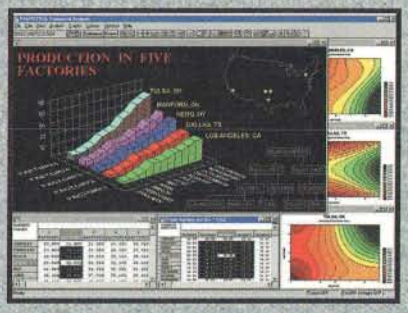

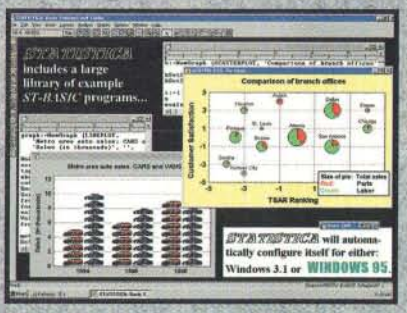

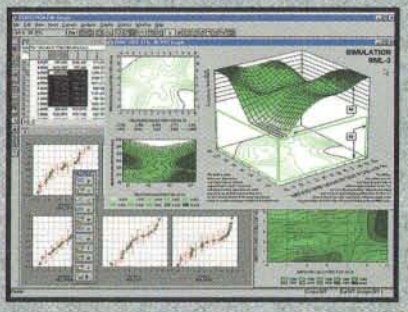

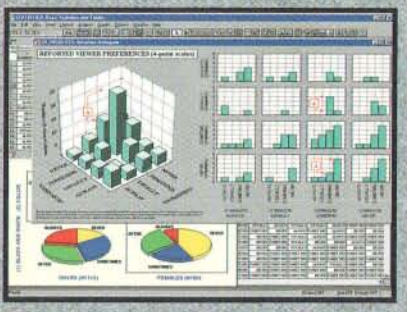

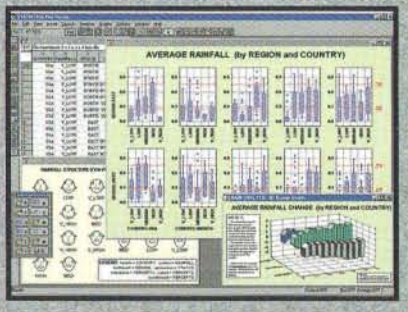

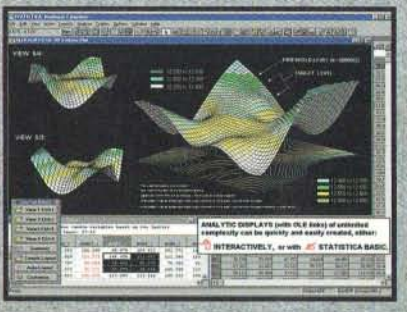

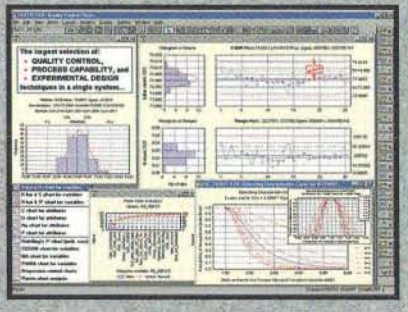

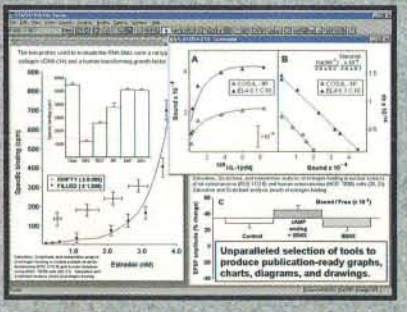

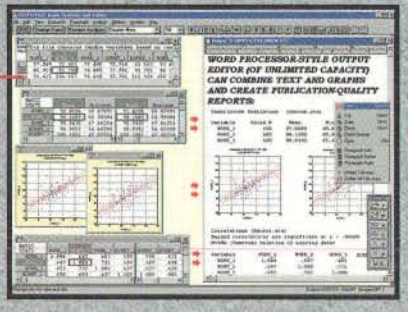

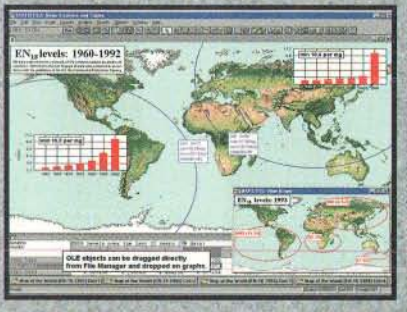

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Satellite System Overview

System type	Frequency bands	Applications	Terminal type/size	Examples
Fixed satellite service	C and Ku	Video delivery, VSAT, news gathering, telephony	1-meter and larger fixed earth station	Hughes Galaxy, GE American, Loral Skynet, Intelsat
Direct broadcast satellite	Ku	Direct-to-home video/audio	0.3–0.6-meter fixed earth station	DirecTV, Echostar, USSB, Astra
Mobile satellite (GEO)	L and S	Voice and low-speed data to mobile terminals	Laptop computer/ antenna-mounted but mobile	Inmarsat, AMSC/TMI, ACES
Big LEO	L and S	Cellular telephony, data, paging	Cellular phone and pagers; fixed phone booth	Iridium, GlobalStar, ICO
Little LEO	P and below	Position location, tracking, messaging	"As small as a packet of cigarettes" and omnidirectional	OrbComm, E-SAT
Broadband GEO	Ka and Ku	Internet access, voice, video, data	20-cm, fixed	Hughes Spaceway, Loral Cyberstar, Lockheed Astrolink
Broadband LEO	Ka and Ku	Internet access, voice, video, data, videoconferencing	Dual 20-cm tracking antennas, fixed	Teledesic, Skybridge, Celestri, Cyberstar

Source: Leslie Taylor and Associates

moment. That allows the high system capacity of the Teledesic network to extend to a very large user base."

Other system operators agree. Savatiel says, "The price can compete with underutilized T1s, like 25 percent utilized T1s." Astrolink will be in the range of 20 to 25 cents per minute for 64 Kbps, but remember that you will pay only for time that you use. "If you provide a good value to end users, you'll be rewarded," says Savatiel. Astrolink will word reseller agreements to try to avoid price gouging—a practice more common in countries where telecommunications is a monopoly. Cyberstar's Maehl puts it a different way: "We're trying to wait to see what the market wants." He sees Cyberstar's service coming in at about $20 per month for basic service on its Ku-band system (which has a lower bandwidth than the planned Ka-band system) and a similar price on its eventual Ka-band system.

The price you see as a customer, however, is likely to be set by your service provider. Satellite system creators are wholesale service providers. None of the satellite systems will be selling bandwidth to end users. They'll sell to gateway providers such as telephone companies, who will probably resell the satellite bandwidth to service providers (like ISPs), who will sell to customers.

The goal is to make the satellite systems transparent to end users—you buy the service, and somebody else worries about the plumbing. This transparency is incredibly important. Cyberstar, for example, is working on deals with router vendors to facilitate intelligent routing of hybrid networks. "Satellite guys can't just do satellites—we have to know about the network architecture as well," says Maehl.

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Shooting for the Stars

According to analysts conducting research for Motorola, the total telecommunications market is about $650 billion, and that's going to double in 10 years, chiefly due to data communications. In other words, there are a whole lot of people out there needing a whole lot of bandwidth. And we'll need every hose we have to put out that fire: fiber, ATM, Synchronous Optical Network (SONET), xDSL, Gigabit Ethernet, cable modems, satellites, and probably a few that haven't even been thought of yet.

"I don't think the fact that it's a satellite system is going to make a difference," says Guy Christensen. He sees all telecommunications systems competing on their availability, price, and speed. That means there are going to be two big winners: whoever gets its broadband service to consumers first, and whoever can offer the most bandwidth with at least not-unreasonable latency.

At this point, the race could fall to any of the companies putting together a broadband satellite system. Or even to someone we've never heard of. The profile of the broadband satellite race has changed a great deal since last spring. AT&T has dropped out. Teledesic changed its configuration. And Motorola is collapsing two of its systems (M-Star and Millennium) into Celestri.

Gentleman, to your launch pads. B

John Montgomery is BYTE's West Coast bureau chief. You can reach him at **jmontgomery@dev5.byte.com.**

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Socket to Me

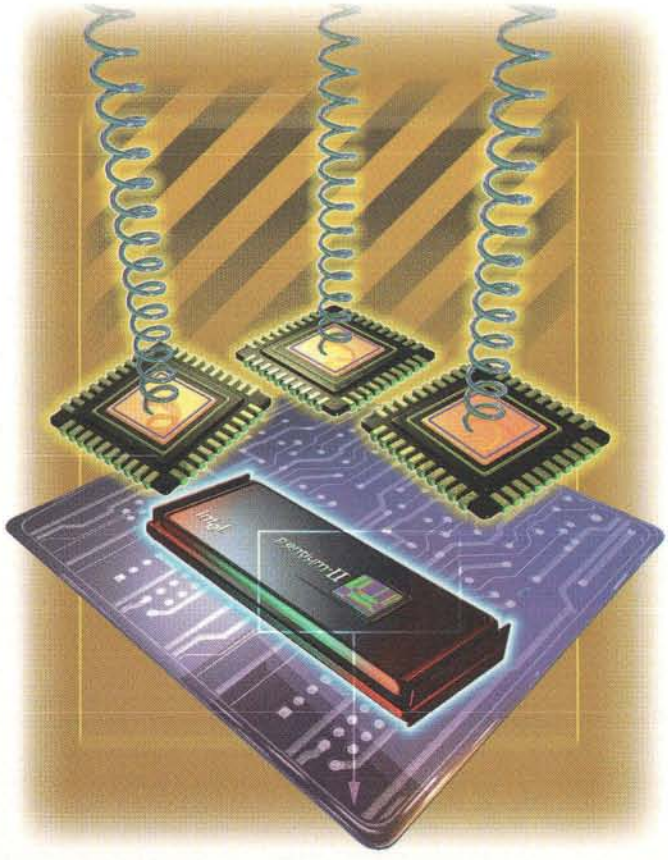
The Pentium II's proprietary slots could extend Intel's control over the PC architecture. That's bad for Intel's competitors. But what does it mean for users?

By Tom R. Halfhill

You can't fit a square peg in a round hole. And lately, Intel has much of the PC industry feeling like a square peg. The round holes are the new CPU interfaces Intel has been introducing for its P6-class processors. They are making it more difficult for rival chipmakers to compete with Intel, and they're dividing the industry into camps that are fighting over the future of the PC system architecture. Caught in the crossfire are users. Will the PC standard they've always thought was open soon become proprietary?

It all started in 1995 when Intel introduced the first P6-class microprocessor, the Pentium Pro. At the same time, Intel rolled out a new interface—called Socket 8—that connects the Pentium Pro CPU to the motherboard. The 387-pin Socket 8 was incompatible with Socket 7, which is the standard 296-pin ZIF socket used by all P5-class processors, including Intel's own Pentiums, Advanced Micro Devices' K5 and K6, Cyrix's 6x86 and 6x86MX, and Centaur Technology's new IDT-C6.

Last May, Intel introduced another P6-class processor, the Pentium II, and another new CPU interface, Slot 1. Electrically, Slot 1 is identical to Socket 8. But physically, the Pentium II and Slot 1 represent major departures from past standards.



Instead of selling the CPU in a small ceramic or plastic package studded with pins—the flat, black square commonly referred to as a chip—Intel encloses the Pentium II in a much larger carrier known as a Single Edge Contact (SEC) cartridge. It's really a daughtercard sealed inside a protective housing, and it's the only way anyone can buy a Pentium II. The SEC cartridge requires a 242-contact Slot 1 on the motherboard.

Intel isn't stopping there. In mid-1998, the company will introduce another Pentium II processor (code-named Deschutes) and another interface for desktop systems, Slot 2. For notebook computers, Intel will introduce a miniaturized version of the SEC cartridge and a miniaturized version of Slot 1, which will also work with Deschutes-series processors.

It's the biggest barrage of CPU interfaces in industry history, but that's not the problem. The problem—from the viewpoint of Intel's competitors—is that all these new sockets and slots are Intel's proprietary technology. And Intel doesn't want to share them with just anybody. The chip giant is guarding the new interfaces with strong patents that make reverse-engineering a much greater legal challenge than a technical challenge. Although Intel allows motherboard manufacturers to use the new interfaces, it won't license them to rivals who produce x86-compatible processors. And that puts many companies in a difficult position.

AMD, Cyrix, and Centaur can't make processors that fit motherboards with SEC slots. Vendors of core-logic system chip sets can support the slots, but only if they can license proprietary technology from Intel. Motherboard companies can't make motherboards that accept P6-class processors from any x86 vendor, as they can today with Socket 7 and P5-class processors. They also can't make Socket 7 motherboards with Intel's latest system chip sets (because the chip sets aren't compatible with Socket 7), and they face a more limited choice of chip-set suppliers for SEC motherboards because some would-be suppliers don't have an Intel license.

These are unexpected obstacles for an industry that has been comfortably making PC clones for more than a decade. Motherboard makers have to choose sides because it costs too much to build motherboards with both a Socket 7 and an SEC slot. Users will have to make a choice, too.

One solution, of course, is to stick with Intel, whose processors offer the best all-around x86 performance (integer, FP, MMX). But Intel CPUs cost about 25 percent more than CPUs

ILLUSTRATION: ROY WIEMANN © 1997

from other x86 vendors, and SEC motherboards cost $30 to $100 more than Socket 7 motherboards.

The PC market has always thrived on competition. But now it's almost as if PCs are following the lead of the Macintosh—a historically proprietary architecture that's going proprietary again after a brief fling with cloning.

What's Open?

It's easy to portray Intel as the bad guy. "Intel is trying to do exactly what IBM tried to do in 1987 by driving the industry toward a proprietary bus, in that case Micro Channel," says Glenn Henry, president of Centaur Technology and a former IBM Fellow. "In fact, that's one reason why I left IBM. I thought they were being stupid."

Henry is referring to IBM's Micro Channel architecture, an internal peripheral bus that IBM pushed as the successor to ISA. Micro Channel was a proprietary bus that other companies had to license from IBM. If successful, Micro Channel might have forced some clone companies out of business and restored IBM's control over the PC architecture it invented in 1981. But the bus failed to catch on. "Customers voted Micro Channel out of existence," says Henry. "Now it's in the Computer Hall of Shame."

Without question, Intel is gradually establishing control over the PC architecture. The critical components of a PC are the CPU, the system chip set, the graphics controller, the memory chips, and the motherboard. Intel makes about 90 percent of the CPUs and 80 to 85 percent of the system chip sets. Intel is also the leading motherboard manufacturer.

Intel recently announced its intention to acquire Chips & Technologies, which makes key components for notebook computers and is working with Intel and Hughes to develop a 3-D graphics controller chip (code-named Auburn); this controller is a threat to companies such as S3. Intel also owns part of Rambus, which stands a good chance of setting the future standard for memory chips. Intel and Rambus are promoting Rambus DRAM (RDRAM) as the successor to synchronous DRAM (SDRAM), which would mark the first time since 1974 that a single company controls the DRAM standard.

Not since IBM's heyday in the early 1980s has a company enjoyed so much dominance over the PC architecture. And Intel has done it without selling a single PC under its own name. It seems the only thing beyond Intel's reach is the OS, which is still firmly in the grip of Microsoft.

Does that make Intel the Evil Empire? Before indulging too deeply in conspiracy theories, keep four points in mind:

- Like any company, Intel has a right to invent technologies and protect them with patents. "As an Intel stockholder, I would get very upset if Intel gave away its most valuable secrets without getting anything for them," says Manny Vara, Intel's public relations manager for desktop CPUs.
- Intel had solid technical reasons for inventing a new CPU interface. Socket 7 doesn't have enough bus bandwidth for high-end systems and servers, especially multiprocessor (MP) configurations. All bus traffic on Socket 7 moves across a single 64-bit-wide bus. At the typical bus frequency of 66.6 MHz, that's about 533 MBps of peak bandwidth. Even when the bus frequency increases to 100 MHz next year, it still won't be enough for high-end systems. (See the figure "Comparing Peak Bus Bandwidth," page 75.) So Intel added a second 64-bit-wide bus to the Pentium Pro and Pentium II. This backside bus talks independently to the Level 2 (L2) cache and runs faster than the frontside bus. It needs at least 72 more pins than were available on Socket 7.
- Not everyone is frozen out; Intel does share some of its P6 technology with others. For example, it helps companies such as Corollary, NCR, and Hyundai develop P6-compatible chip sets for MP systems with more than four CPUs. Intel says those

Sorting Out the Slots

All of Intel's P6-class processors use a similar electrical interface—only the physical interfaces are markedly different. Is this a ploy to make the interfaces more difficult to clone? No, because the physical connectors are available from independent suppliers, and anyone can use them. Intel's patents protect the bus protocols, not the sockets and slots themselves.

Instead, Intel is trying to match each interface to the processor package and to different markets. Here's how they break down:

Socket 8 is a 387-pin ZIF socket for the Pentium Pro. It requires a multichip module—a special chip package that includes a CPU die and one or two SRAM die for the Level 2 cache (256 KB to 1 MB). The L2 cache can run at the full core frequency of the CPU (currently up to 200 MHz). The Pentium Pro supports an L2 cacheable address space of 64 GB and is found in high-performance desktops and servers.

Slot 1 is a 242-contact daughtercard slot that accepts a Pentium II processor packaged as a Single Edge Contact (SEC) cartridge. Inside the cartridge are the CPU die and enough SRAM chips for an L2 cache of up to 512 KB. The current Pentium II supports 512 MB of cacheable address space, much less than a Pentium Pro. Motherboards can have one or two of these slots. The frontside bus usually runs at 66.6 MHz and will increase to 100 MHz when Intel introduces the 440BX system chip set in the first half of 1998. The L2 cache can run at a 1:1, 1:2, or 1:3 ratio of the core frequency. However, it typically runs at 1:2 because higher frequencies would require expensive SRAMs, and Intel aims Slot 1 at mainstream desktops and servers.

Slot 2 is a new daughtercard slot that will accept Pentium II processors packaged in a slightly larger SEC cartridge. Slot 2 will not replace Slot 1. Instead, Intel will aim Slot 2 at higher-end desktops and servers. Motherboards can have up to four of these slots for glueless multiprocessing, and even more by using custom chip sets. There's room inside the larger cartridge for more SRAM chips—enough for L2 caches well beyond 512 KB. Slot 2 processors will support much more cacheable memory than Slot 1 processors (probably 64 GB). By using expensive burst SRAMs, the L2 cache can run at the full core frequency. The frontside bus won't run slower than 100 MHz.

Intel's **mobile slot** (as yet unnamed) is a physically smaller version of Slot 1 for notebook computers. Otherwise, it's the same as Slot 1. Intel also sells mobile processors on a small card known as a mobile module.

Contrary to some reports, future P6 chips aren't necessarily tied to specific slots. For example, the Deschutes processor—slated for mid-1998—is simply a Pentium II fabricated on a 0.25-micron process. (Current Pentium II chips are 0.35-micron.) Deschutes will arrive at clock speeds of 333 MHz and higher, and it will gradually replace today's Pentium II. There will be versions for Slot 1, Slot 2, the mobile slot, and the mobile module.

companies "advance the PC architecture," while rivals such as AMD and Cyrix merely undercut Intel's market share.

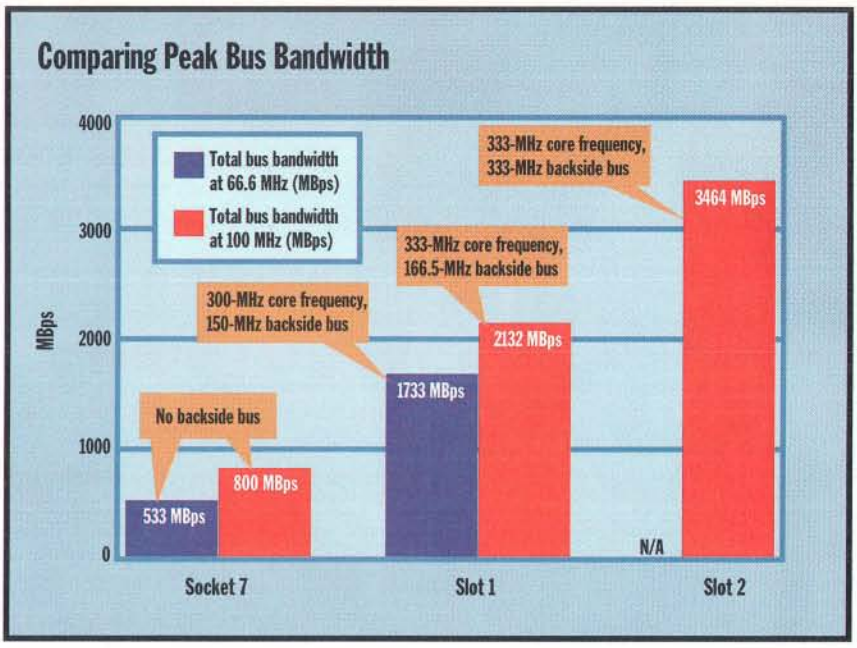
• Intel can't make the PC architecture proprietary because it was never truly open to begin with. This runs contrary to common wisdom, which holds that PCs are more popular than Macs because they're an open standard that anyone can clone. But in fact both the IBM PC and the Mac were proprietary from the start. The PC was cloned only because it was easier to clone. By inventing a bus protocol that's difficult to duplicate, Intel is proving that PCs aren't as open as many people think.

Preserving Socket 7

All this might seem to doom Socket 7 and Intel's competitors to the endangered species list. Not necessarily. Although Socket 7 lacks the bandwidth needed by high-end systems, it's still good enough for low- to mid-range systems—the kind most people buy. That also happens to be the mainstream market coveted by AMD, Cyrix, and Centaur.

"We are not limited by Socket 7. That's the clear message I want to get across," says Lance Smith, AMD's technical marketing director. "We're limited by time, more than anything else—the time we need to get new products out the door."

Early next year, new CPUs, system chip sets, motherboards, and SDRAMs will boost Socket 7's bus frequency to 100 MHz. That will boost the bandwidth to 800 MBps—50 percent more than today's 533 MBps at 66.6 MHz.



Intel's CPU slots offer more peak bus bandwidth than Socket 7 because they drive a backside bus at higher frequencies.

Meanwhile, engineers are striving to reduce bus traffic. Enlarging the Level 1 (L1) cache increases the possibility that a CPU will find the instructions and data it needs without venturing out on the bus. All CPUs have bigger L1 caches these days; AMD, Cyrix, and Centaur include 64 KB in their latest chips. That's twice as much cache as Intel's Pentium, Pentium Pro, and Pentium II chips.

It's likely that AMD will add even more cache when the K6 moves from its current 0.35-micron fabrication process to 0.25-micron in the next few months. The smaller process will shrink the die from its current size of 162 square millimeters to a miniscule 68mm^2. That leaves plenty of room to add cache while still holding down the cost.

Centaur is taking a similar approach.

Seven Ways to Boost Socket 7

	PROS	CONS	LIKELY PLAYERS
1. Speed up the CPU bus	Faster overall performance for L2 cache and main memory	More expensive motherboards; probably fewer motherboard suppliers	Everyone
2. Enlarge the L1 cache	Higher rate of cache hits	Consumes more silicon area on the microprocessor	AMD
3. Enlarge the L2 cache	Higher rate of cache hits	Requires more SRAM chips	Unknown
4. Add an L2 backside bus	Separates cache traffic from frontside bus traffic	Adds expense to microprocessor and requires a daughtercard that plugs into Socket 7	Unknown
5. Integrate the L2 cache	Greatly speeds up access to L2 cache; eliminates need for external L2 cache or allows optional L3 cache	Consumes more silicon area on the microprocessor	Centaur, AMD
6. Use an in-line L2 cache	Speeds up access to L2 cache; doesn't consume any silicon area on microprocessor	Complicated design with multiple bus speeds; requires a daughtercard that plugs into Socket 7	System chip-set suppliers
7. Integrate the L2 cache in a multichip module (MCM)	Speeds up access to L2 cache over dedicated backside bus; doesn't require a daughtercard	Prohibitively expensive unless manufactured with IBM's C4 process technology	AMD, Cyrix

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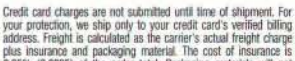

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Late next year, the company plans to ship an improved version of the IDT-C6 processor that integrates the L2 cache with the CPU—already a feature in some RISC chips but a first for the x86.

Glenn Henry estimates that an eight-way set-associative 256-KB L2 cache in the CPU could yield the same hit rate as the direct-mapped 512-KB L2 cache found in most of today's PCs. Yet the integrated cache would be significantly faster than an external cache because it's synchronized to the CPU's core frequency, not to the slower bus frequency. And the integrated cache would reduce bus traffic.

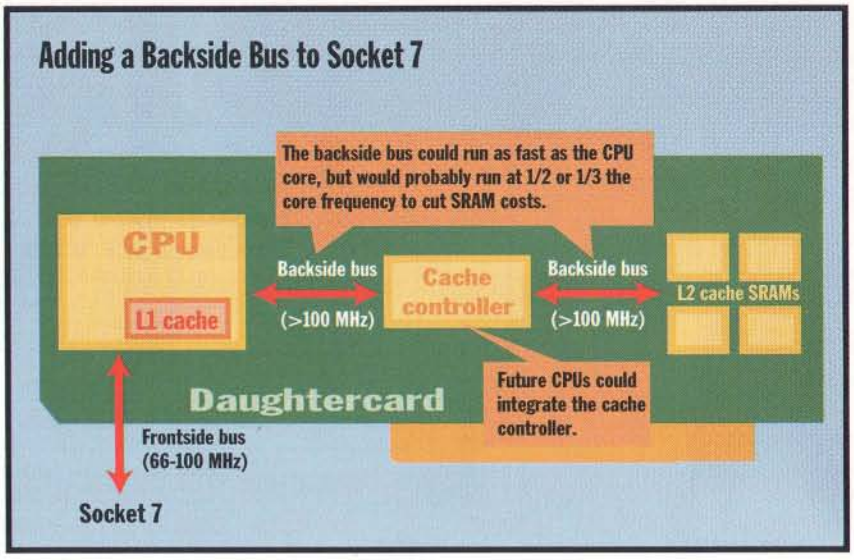
"Even if you didn't know anything about the PC industry, an economist from Mars could look at it and recognize there's plenty of room for many companies to compete," says Henry.

Future Alternatives

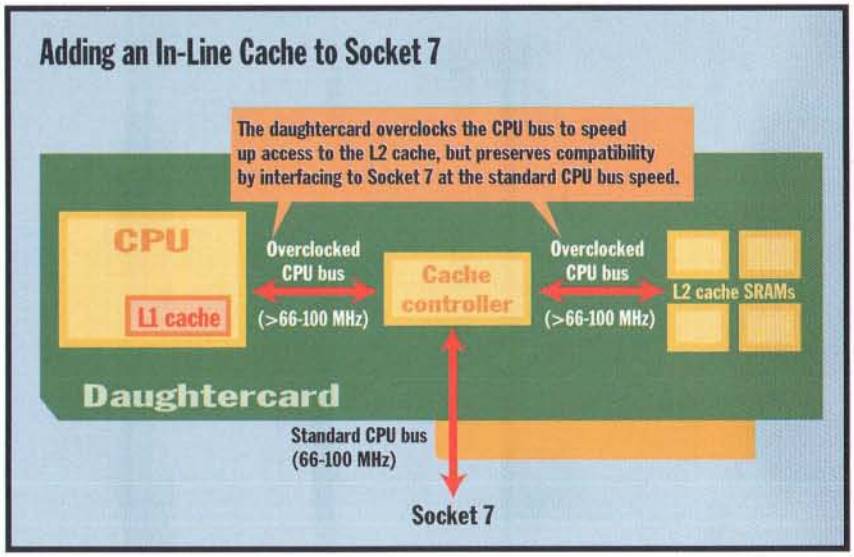
Bigger on-chip caches aren't the only options available to the Socket 7 preservation society. There are some more short-term solutions as well as some new alternatives beyond Socket 7.

One option is to design new CPUs with a backside bus for the L2 cache, just as Intel has done. But instead of inventing a new socket to accommodate the extra pins, the dual-bus CPU and L2 cache would sit on a daughtercard that plugs into Socket 7. The backside bus could run as fast as the CPU core, or at some fractional speed—probably half the core frequency, to reduce SRAM costs. The frontside bus would still run at 66.6 or 100 MHz for backward compatibility. (See "Adding a Backside Bus to Socket 7," at right.)

The same thing could be done even better by integrating both the CPU die and the L2 cache in a single package called a multichip module (MCM), much like the Pentium Pro. The core and the cache would communicate over a fast backside bus, and the MCM would fit Socket 7. (See the figure "Multichip Modules for Socket 7," page 80.) MCMs are costly to manufacture, but AMD uses an IBM fabrication technology called C4 that would make it more economical. This technology distributes the pads (the contacts to which the pins are wired) all over the chip's surface instead of only around the edges of the die, which is the more common pad-bonding technique. Among other benefits, C4 makes it less expensive to bond another die on the same substrate. NexGen, which was acquired by AMD, did something similar two years ago: One version of the Nx586 processor had a separate FPU in an MCM. This option is also possible (but less likely) for Cyrix, whose manufacturing partner is IBM.



CPU designers could make a Socket 7–compatible backside bus by segregating the L2 cache on a daughtercard.

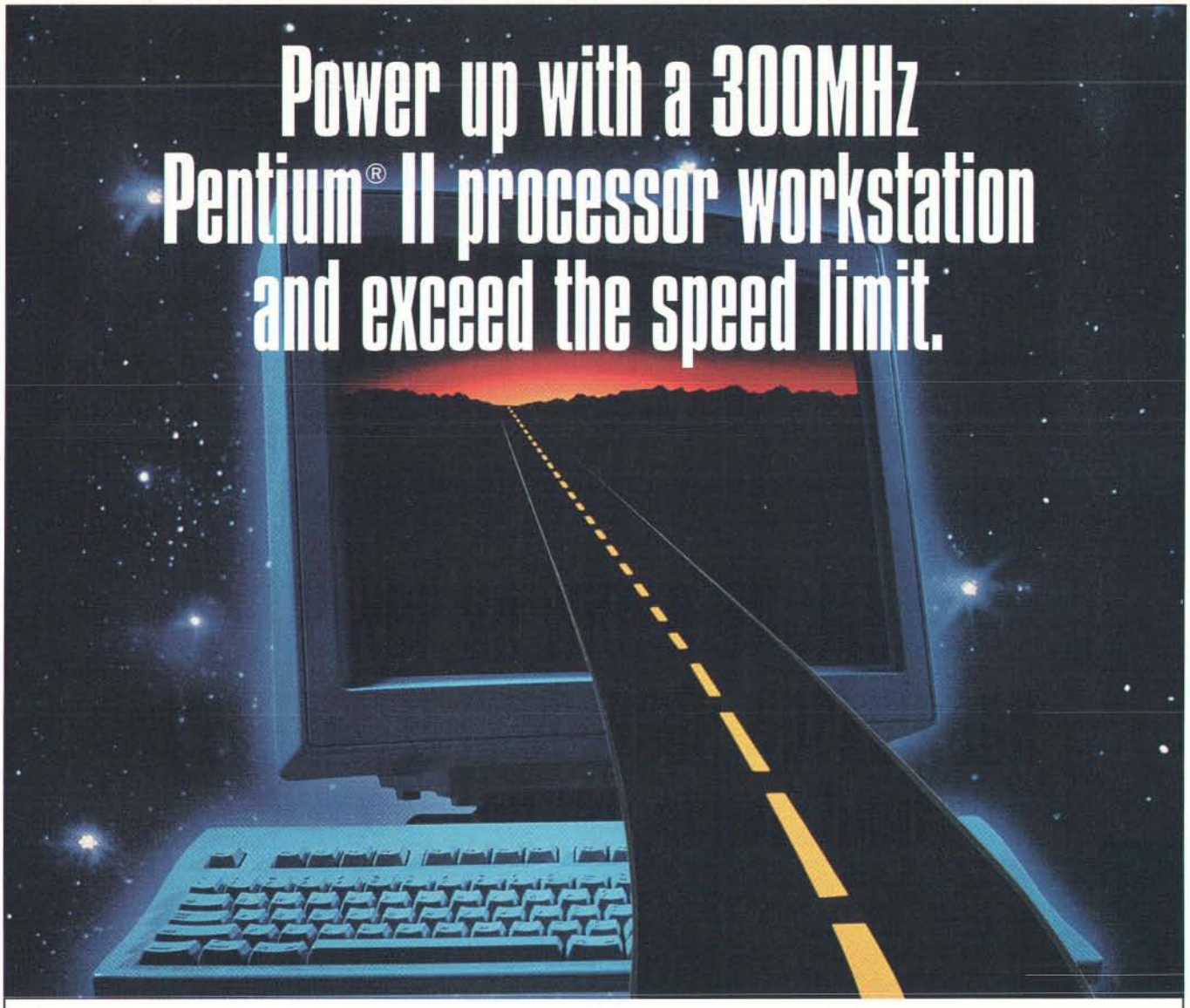


An in-line L2 cache doesn't require a backside bus, so it would work with existing processors.

Another option is to add an in-line or look-through L2 cache to a daughtercard that plugs into Socket 7. In this scheme, the CPU wouldn't need a backside bus. Instead, an external oscillator overclocks the CPU bus to drive it at a higher-than-normal frequency. The CPU talks to the L2 cache at this higher speed, but the cache controller steps down to 66.6 or 100 MHz when communicating over the daughtercard's interface to Socket 7. This option saves the trouble of designing new CPUs. Some of the latest Macs and Mac clones are using in-line caches to overcome their slow 40- and 50-MHz buses. (See the figure "Adding an In-Line Cache to Socket 7," above.)

"Any one of those alternatives could extend the life of Socket 7 and match the performance of Slot 1," says Mark Bluhm, vice president of strategic planning at Cyrix. "This socket has at least another year or two of life ahead of it."

continued



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Circle 123 on Inquiry Card (RESELLERS: 124).

Beyond that, however, even the Socket 7 advocates admit they'll need a longer-term solution. If they can't get around Intel's patents by then, they've got two more alternatives: Agree on a universal motherboard slot that accepts daughtercards with any kind of CPU, or invent a new socket or slot that competes directly with Intel's slots.

The first alternative already exists, though it's not universal. At the Computex show in Taipei last June, Asus won a BYTE Best of Computex award for a motherboard (the P/I-P65UP8) with a special slot for CPU daughtercards. The daughtercards may contain a Socket 7, Socket 8, or Slot 1 processor, along with the appropriate system chip set. In this way, Asus needs to make only one motherboard that works with anyone's CPU. The daughtercard slot is proprietary for now, but if enough companies agreed on a standard, any company could build universal motherboards.

One drawback is that this design needs an additional edge connector (the universal daughtercard slot) between the CPU and the motherboard. If the CPU is a Pentium II, there are two edge connectors between the CPU and the motherboard—Intel's slot and the universal daughtercard slot. Edge connectors can be troublesome sources of noise and signal delays at higher bus frequencies.

The second alternative is for the rebel faction of the industry to agree on a new CPU interface to supersede Socket 7 without stepping on Intel's patents. "We believe the industry wants that to be an open socket," says Stan Swearingen, product management director at Cyrix. "We're already talking to chip-set vendors, AMD, and other companies to define a new interface."

None of those companies wants to reveal much about their negotiations at this point. But even if they can agree on a new socket, they still face a formidable obstacle: Intel.

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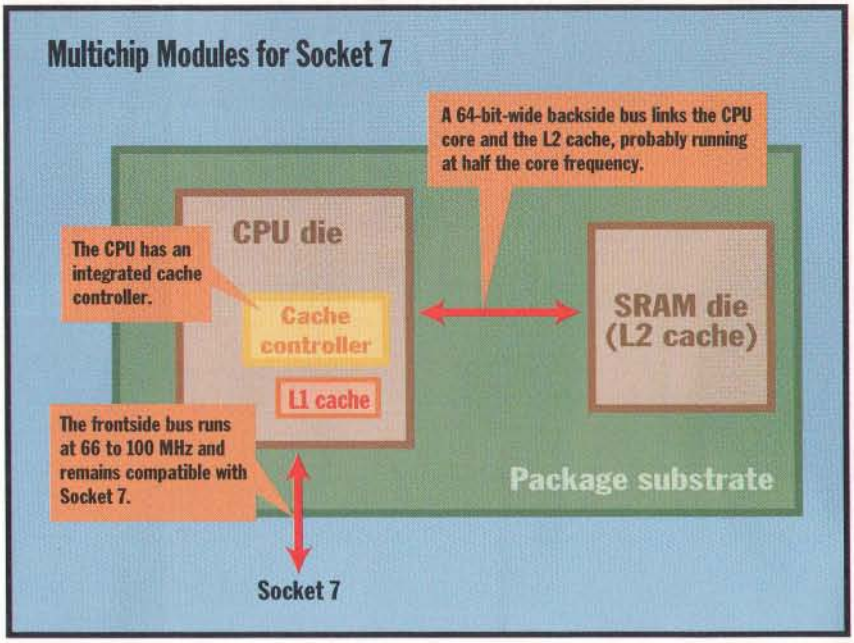

Packaging the L2 cache in an MCM would deliver the benefits of a backside bus without the drawbacks of a daughtercard.

Whatever new interface the contras come up with, it won't be supported by the industry's leading CPU maker (Intel), the industry's leading motherboard maker (Intel), and the industry's leading system chip-set maker (Intel). The fallout could be two PC architectures: one controlled by Intel and the other supported by a majority of the industry that nevertheless controls only a minority of the market share.

Users Will Choose

Users could tip the scales either way. Will they be comfortable with a PC architecture largely controlled by Intel, or will they rebel? When BYTE put this question to users in our on-line conferences (http://www.byte.com), the answers were interesting. Some people denounced what they perceived as Intel's attempt to hijack the PC standard. But when they considered the alternatives—basically either boycott Intel or buy a Mac—they weren't so adamant. It's not easy to go cold turkey on Intel. The Pentium is popular because it's a good product, not because it has the best TV commercials.

For users who prefer to buy Intel-based PCs anyway, it's not a dilemma. Nor is it likely to matter to the growing number of users who don't know a motherboard from a surfboard. Performance-minded users who buy MP systems and high-end servers will have to choose Intel in any case because AMD, Cyrix, and Centaur say they're not competing in that space.

Comparisons to the Micro Channel architecture go only so far. Micro Channel was a peripheral bus, so it affected users more directly than a CPU bus does. And IBM had to persuade other companies to make compatible cards, while the whole point of Intel's new slots is that nobody else can make compatible cards.

Motherboard makers' support is seen as a determining factor to the continued success of Socket 7. A sampling of Taiwan motherboard makers said they were going both ways, designing boards to accommodate standard Socket 7 processors as well as Intel's new vertical-insert design.

Motherboard makers also say that Intel's actions could encourage them to use more non-Intel processors. An official at one company (who asked BYTE to withhold his firm's name) said the industry wants alternatives to Intel because nobody wants their future to be determined by a single vendor. When there are CPU shortages, it's common for smaller companies to suffer from short allocations.

Intel is taking the PC into unexplored territory. Chances are, most PC users will follow. B

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Déjà Vu All Over Again

Windows NT security is under fire. It's not just that there are holes, but that they are holes that other OSes patched years ago.

By Peter Mudge and Yobie Benjamin

Do you have a strange feeling? The feeling that you've been somewhere or done something before? It's déjà vu, and we're developing a serious case of it as we hunt down bugs in Windows NT. It's not strange that there are bugs in it. We certainly have not come across any OS or piece of software that is bug-free.

The peculiar feeling comes from the fact that the bugs we're seeing are the same security holes that were fixed many years ago in older OSes.

Why hasn't anybody noticed until recently? The Internet is largely a network of Unix computers, so hackers aimed their sights on the thousands of Sun, Hewlett-Packard, and IBM servers on it. NT was largely ignored. Microsoft's marketing juggernaut changed that. The hacker community targeted NT security starting in the fall of 1996, and the rash of security breaches has been relentless ever since.

The shame of it is that none of these threats are new to the security world. Why does an OS only five years old (compared to Unix's 25-year history) have these problems? NT may be another example of the veracity of Santayana's statement that "those who cannot remember the past are condemned to repeat it."

ILLUSTRATION: SCOTT BALDWIN © 1997

Let's look at NT's security by highlighting some of the breaches, how they work, and what you can do about them.

Denial of Service Attacks

Denial of Service attacks, commonly referred to as DoS, make a machine unusable. They range from shutting services off to blue screen of death (BSOD) attacks to devoting resources to one process and thus depriving other tasks of any sort of sizable time slice. In general, DoS attacks do not require user names or passwords. Instead, they work by combining the inherent weaknesses of TCP/IP and the OS. Let's take a look at four examples: WinNuke, Domain Name System (DNS), Internet Information Server (IIS) 1.0, and Microsoft remote procedure call (RPC).

WinNuke is particularly troublesome. Most of the NT boxes out on the Internet are still vulnerable to this attack. We don't know just who came up with the first example of WinNuke or found the initial problem. Our apologies for not being able to give credit where it is due. The scenario goes something like this.

A cracker makes a TCP connection to a machine running Windows 95 or NT. As soon as the connection is made, and before any regular data is sent, the cracker transfers a message over the connection with the Out of Band (OOB) flag set. This flag normally signals an application that some information needs to get through right away and cannot wait in the regular data stream to be processed. The paradox here is that there is no data in the regular stream.

In an unpatched or underpatched NT machine, your screen turns a nice shade of blue. You must reboot to clear this problem.

The moral of this example? TCP stacks are not the easiest things in the world to write. Users continue to find bugs in most vendors' implementations. The one stack that is probably closest to being bulletproof is BSD Unix. What's more, the source code for this more robust and quicker stack is free. The only catch is that the license states you must mention that parts of your product were derived from Berkeley code if you use it.

NT also had problems with DNS. DNS is responsible for mapping numbers such as 10.23.143.12 to names such as foo.bar.com.

continued

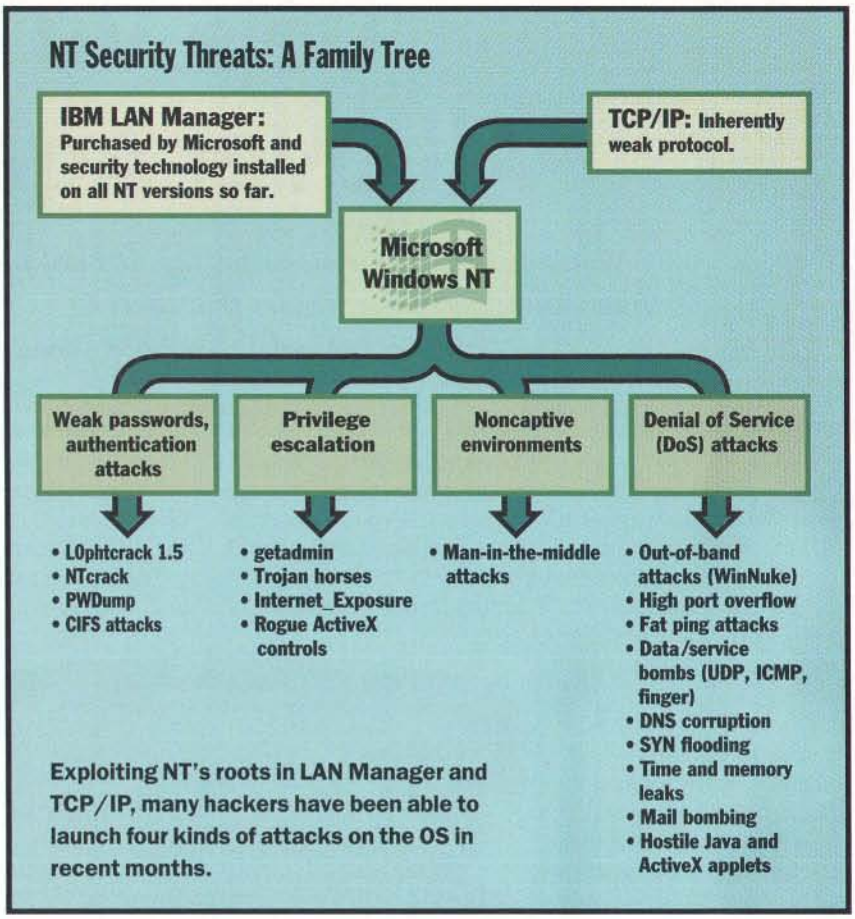
It is in much need of an overhaul, but it's entrenched in how the Internet works.

The Canadian company Secure Networks found a problem in Microsoft's implementation of DNS. The standard operation for a DNS server is to field queries and send responses or send queries and field their associated responses. What happens when you send a response to a nonexistent query? The DNS server dies, most likely as a result of trying to reference a fictitious ID number in the DNS packet.

IIS 1.0 had a similar problem. All someone with malicious intent or sloppy fingers had to do was request a URL in the form of http://www.someiismachine.com/../../../.., and the Web server would stop running. An easier way of doing this was simply to telnet to port 80 of the target machine and type "GET ../.." Why did the server die? Probably, this is a case of requesting a file handle, getting a NULL pointer in response, and trying to dereference the NULL pointer.

Finally, and not because we are running out of DoS attacks on NT, but because we don't want to write exclusively on ways to make your NT network unusable, we have the problem of how a program should respond to unexpected or erroneous input. There are three possible responses to this question: Ignore the input, report the error and terminate gracefully, or act in an undefined manner (the program dies from a segmentation fault or a bus error, munges its stack frame, or sits there spinning its wheels in an endless loop).

We believe most people would prefer either of the first two responses to the third. Unfortunately, however, the last one is what happened to most Microsoft services that listened on the network.



Windows NT 4.0 Service Pack 3 fixed the port 80 OOB attack, but crackers struck again. By connecting to port 135 of an NT machine and letting your 2-year-old bang away at the keyboard for a second, you would leave the program previously listening on that port spinning its wheels and pegging the CPU use at 99 percent. Microsoft plugged the port 135 hole in one of the 14 patches to Service Pack 3, but there are probably more TCP/IP bugs remaining than we'd care to think about.

Noncaptive Environments

In many situations, it is necessary to give someone or something limited access to your system. It is not necessary for everyone who connects to your FTP or Web server to have access to your main C or D drives. In the case of HTTP servers, all that people will usually need is the document root.

For example, if your Web tree lives in c:\users\web\html and your main page is c:\users\web\html\index.htm, users should be able to request http://your.site.com/index.htm. Thus, \users\web\html looks like \ to the foreign entity. The same holds true for FTP servers, file sharing, and the like.

In the Unix world, administrators found that you had to double-check to be sure that restricted environments were really restricted. Administrators found this out the hard way and fixed it over time. Now it's Microsoft's turn to learn for itself. It's also possible that Unix vendors had an easier time of it, because the

NT Watchdogs for Hire

No add-on or accessory can close Windows NT's holes, but they all claim to help you tackle the job of guarding NT servers in more systematic ways. Internet Security Systems (http://www.iss.net) recently released RealSecure 1.0 for NT 4.0, featuring an automated, real-time attack recognition and response system, and a significantly enhanced management console, including predefined engine configuration templates. It also features built-in reporting capability, an ODBC-compliant database, and the ability to recognize attacks in a Windows networking environment. Network Information Technology (http://www.nit.com) offers UniShield APD for Windows NT. UniShield's publishers say it transparently enforces security policies and audits all administrative activity, irrespective of whether such activity originates from the native NT programs such as User Manager or Server Manager, Net Commands, or third-party software developed using Net API functions. Axent Technologies (http://www.axent.com) claims to guard against NTCrack, insecure registry, and the anonymous log-on loopholes, with OmniGuard/Enterprise Security Manager 4.4.

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Circle 108 on Inquiry Card (RESELLERS: 109).

Unix source code they released actually helped hackers find and plug security holes.

In some versions of Microsoft's Web server, FTP server, and file sharing, it was possible to believe you were sitting at \, attempt to go up a level anyway, and magically find yourself outside your restricted environment. Although Microsoft has since patched the flaw, the idea that it could introduce the flaw years after the Unix community identified the problem is troubling.

Privilege Escalation Attacks

ActiveX and Java have provided a wellspring of privilege escalation attack opportunities. Some of the most interesting attacks involve the construction of hostile Java, ActiveX, or plain old C++ Trojan horses.

In theory, Authenticode gives a level of protection against Trojan horses. ActiveX controls are signed by certificate authorities and must identify their creators before they run. You get to decide if the creator should be trusted. Regardless of Microsoft's threats of litigation, however, unscrupulous crackers will still find people to sign their ActiveX controls.

In the ActiveX/Authenticode security model, once a source is trusted, it is always trusted. For example, users who go to Microsoft's Web site are sent a flood of ActiveX controls without warning, because the controls came from a trusted source—Microsoft. What if a rogue Microsoft employee decided to modify registry settings, plant backdoors for later use, or deposit logic bombs? An example of a rogue ActiveX control, called Internet_Exposure, can be found at http://www.network-security.com/nt/internet-exposure.

In addition to the Trojan horse examples, a slick program entitled getadmin was recently released by Konstantin Sobolev, who wrote it in Russia, according to one security expert. This program found functions the NT kernel was providing that would let nonprivileged processes attach to memory areas that they should not be allowed to touch and modify the contents.

The result? A tool that would let an ordinary account convince the system it was just debugging something and place the account in the Administrator group of an NT domain. The next time you logged in, you had full rights to the system. This avenue seems ripe for exploration as Microsoft pulls more and more of the services that used to live in user space into kernel space. Any bug or lack of validity checking in userland gets much worse if it continues to exist in kernel space. As expected, getadmin has been ported into an ActiveX control and an application that a Trojan horse can deliver.

At press time, Microsoft has issued two patches for getadmin, the second of which was headed for NT 4.0 Service Pack 4, but each works only in certain cases. Neither will work if you have any software developers on your system, because they need to be given permission to attach to processes for debugging purposes.

Weak Passwords/ Authentication

A while back, a white paper on insecurities and potential flaws in Microsoft's CIFS specification (its replacement for NFS and how all systems will share files across networks in the future) was posted on the Internet. The paper, which was by

Password Protection at a Price

On July 14, 1997, Microsoft quietly admitted a major security problem with all versions of Windows NT. Simply put, the encryption implementation in NT 4.0 makes it possible to extract all the LAN Manager and NT user names and passwords in any NT workstation, server, or domain. After this, you can then brute-force the plain-text passwords.

Microsoft Knowledge Base "Document:Q147706" (it can be found at ftp://ftp.microsoft.com/bussys/winnt/winnt-public/fixes/usa/NT40/hotfixes-postSP3/lmfix/Q147706.txt) is a disturbing mea culpa. The essence of the document is that security has a price–a very high price. Microsoft will guarantee security for your network only if all clients and servers are 100 percent NT. If your network has clients that require the LAN Manager protocol, such as Windows 95, Windows for Workgroups, or regular Windows 3.1, anyone with the right tools can intercept the obfuscated user names and passwords, and extract their plain-text equivalent.

A white paper by the researcher known on the Internet as hobbit started it all, analyzing bit by bit the CIFS protocol used by NT. Dominique Brezinski of Cybersafe then released a paper that concentrated on the man-in-the-middle problem in the process. From down under, an anonymous Australian programmer released the source that allowed the programmatic deobfuscation of LAN Manager and NT hashes from the NT registry.

Cygnus programmer Jeremy Allison quickly cleaned it up and released PWDump, which was meant to be a password audit tool for NT. PWDump unleashed a storm of controversy after it was incorporated in a Trojan horse by a Bay Area–based programmer. Later, the hacker group that's known as the L0pht built a sophisticated brute-force password cracker that extracted plain-text passwords from the PWDump hashes.

NT's security is based on two cryptographic methods: the IBM-sired LAN Manager security protocol and the NT security protocol. While each has strengths and weaknesses, together they prove to be disastrous, because the weaker LAN Manager protocol emasculates the stronger NT protocol. Unfortunately, because of backward-compatibility requirements, Microsoft continues to use the weak LAN Manager protocol.

Why is the LAN Manager protocol weak? It's the implementation. In a nutshell, LAN Manager hashes the passwords in a predictable way and does not use salting (the process of inserting several random bits into the hash).

From our research, we have found that you have to go through only seven characters to retrieve passwords (up to 14 characters in length) in the LAN Manager hash. Also, because no salting is being done, constants show up all over the place, giving away too much information and speeding up attacks tremendously.

The first 8 bytes are derived from the first seven characters of the password, and the second 8 bytes are derived from the eighth through fourteenth characters of the password. If the password is less than seven characters, the second half is always the same.

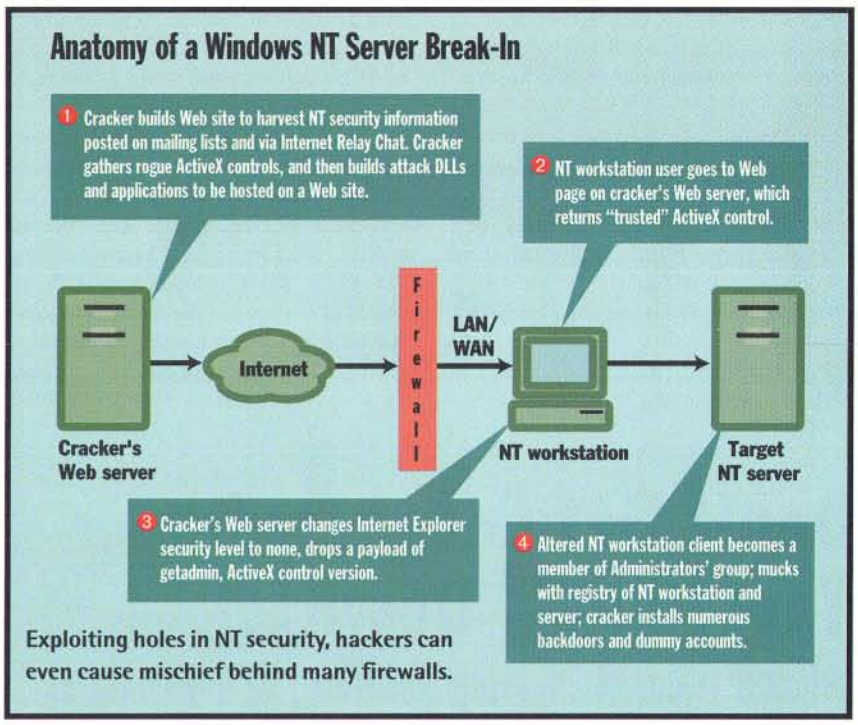
Let's assume for this example that the user's password has an LM hash of -0xC23413A8A1E7665fAAD3B435B51404EE (I will save everyone the nanosecond it would have taken for them to plug this into L0phtcrack and have it tell them the password is "WELCOME").

The following is what happens

hobbit@avian.org and available at http://www.avian.org, pointed out many areas for concern and gave readers enough information and source examples to create their own "probing kit" to check things out for themselves.

One interesting note in the paper was that logging of attempts to connect to file shares was done via the NetBIOS name, not the IP address. Thus, it was trivial to explicitly tell the machine what to log by handing in the NetBIOS information. Walking into work and seeing your logs filled with connection attempts from "HAHAHAHAH" might tell you that you were under attack, but it gives you little information to work with other than a taunting ramble.

In addition to logging, NT provides account lockout "slowdown" solutions to programmatic dictionary or sequential password attacks over the network. In account lockout, the administrator specifies how many invalid attempts it takes before an account is locked out and how long the lockout period lasts. Great, except you can't lock out the Administrator account. If someone renames the Administrator account to try to hide it and leaves a dummy account in its place, you can tell as soon as your automated attack scripts start failing in rapid succession as opposed to slowly and programmatically.



The slowdown solution makes NT introduce a delay between each attempt to authenticate. Ostensibly, this would make it unfeasible for an attacker to launch an

to this hash on the network:

System B sends an 8-byte challenge to system A. (Assume 0x0001020304050607.)

Machine A takes the hash of 0xC23413A8A1E7665fAAD3B435B51404EE and adds five nulls, thus becoming 0xC23413A8A1E7665fAAD3B435B51404EE0000000000. This string is broken into three groups of seven.

The 7-byte strings are str_to_key'd (if you will) into three 8-byte odd-parity DES keys.

Then, 8byteDeskey1 is used to encrypt the challenge 0x0001020304050607. Let's assume the result is 0xAAAAAAAAAAAAAAAA.

Next, 8byteDeskey2 is used to encrypt the challenge 0x0001020304050607. Let's assume the result is 0xBBBBBBBBBBBBBBBB.

Next, 8byteDeskey3 is used to encrypt the challenge 0x0001020304050607. Let's assume the result is 0xCCCCCCCCCCCCCCCC.

The three 8-byte values are concatenated (dumb), and the 24-byte response of 0xAAAAAAAABBBBBBBBBCCCCCCCC is returned to the server. The server does the same thing to the hash on its end and compares the result to the 24-byte response. If they match, it was the correct original hash.

Why is this weak? The first thing we check to see is if the user's password is less than eight characters in length. We do this by taking the 7-byte value of 0x04EE0000000000, turning it into an 8-byte odd-parity DES key, and encrypting it against the 8-byte challenge of 0x0001020304050607. If we get the result of 0xCCCCCCCCCCCCCCCC, we are pretty sure it's fewer than eight characters in length.

To be sure, we can run through 0x??AAD3B435B514 (i.e., 256 possible combinations) to see that 5f shows us that the result is 0xBBBBBBBBBBBBBBBB, proving that the password is less than seven characters and also giving us the last byte of the first half of the LAN Manager hash.

Note that we're not worried about optimizing the way this is done, and that there are much more effective ways to do this that reduce the amount of time required even further. Even so, this shows that even a simplistic attack works against this implementation, and it's no different than how a tool such as L0phtcrack attacks the hashes in the registry.

What if the password is eight characters or more? Let's say that machine A takes the hash of C23413A8A1E766AC435F2DD90417CCD6 and adds five nulls to it, thus becoming C23413A8A1E766AC435F2DD90417CCD60000000000.

The first thing to check is if the password is fewer than eight characters in length. Deriving the 8-byte odd-parity DES key from 0x04EE0000000000 and encrypting against 0x0001020304050607 does not, in this case, give us 0xCCCCCCCCCCCCCCCC, so we know that the password is eight characters or greater.

It takes us, in a worst-case scenario, 65,535 checks to figure out that the 2 bytes that are used in the last third are 0xCCD6.

You can go through your seven-digit combinations of characters for the first third the same way you would the LAN Manager hash from the registry. This will yield not only the first third of the response, but also the first byte of the second third. Keep in mind that you already have the last 2 bytes that made up the final third. You can approach the middle third in the same fashion.

Together, these problems enable utilities such as L0phtcrack to get and decrypt passwords quickly using brute-force methods.

Because opting out of the LAN Manager security model precludes continued use of Windows 95 machines as clients to NT machines, it is still a moot point as to how tough or well done the NT hash might or might not be.

entire dictionary at an account over the net—it would take too long. If you have 1000 words you want to try and the slowdown period lets you try only one word every 2 seconds, it will take 33 minutes to go through them. The problem here is that the slowdown solution works only per connection. To bypass it, simply open 10 connections with different words from the list. Now it will take you only 3 minutes (these numbers are used just as an example).

For more information on this, see http://www.avian.org, http://www.secnet.com, and http://www.L0pht.com for the vulnerability-in-CIFS white paper, the NAT10 auditing tool, and L0phtcrack, respectively.

The encryption implementation in NT 4.0 has left passwords vulnerable to attack (see the text box "Password Protection at a Price"). Microsoft recommends abandoning LAN Manager–style passwords. NT-style passwords can be up to 128 characters in length. These passwords are case-sensitive. NT converts them to Unicode and then runs them through Rivest-Shamir-Adleman's (RSA) MD4 message digest function. The resulting 16-byte value is the NT hash. The only time hackers should be able to retrieve a LAN Manager password and not the NT MD4 version is if the MD4 version is originally longer than 14 characters. But ironically enough, NT's UserManager application won't let you type in a password greater than 14 characters.

Caught Unaware?

Microsoft officials we spoke to downplay these problems and characterize NT as "a very solid and secure OS." According to Enzo Schiano, group product manager for NT Server, "if you compare NT to Unix, we probably have a very, very comprehensive security infrastructure."

But much of Microsoft's advice on its Web site smacks of the obvious: Precautions include reminding users not to pick easily guessable passwords. The Syskey patch to NT 4.0 prevents anyone from reading hash values out of the NT registry. The hacker community is now calling Microsoft's bluff by exposing more holes every day.

Unfortunately, the cracker community is exploiting the revealed vulnerabilities for criminal purposes, and patches such as Syskey hamper administrators, not the crackers. To help administrators test the strength of their encryption, a future version of L0phtcrack will include an NT-based sniffer kit, for reading hash values over the NT server's network.

You can't just blame users who don't adopt or enforce security policies rigorously. DoS attacks, noncaptive environment attacks, and privilege escalation attacks will continue, even through the implementation of Kerberos security in NT 5.0. Eventually, users will complain enough that Microsoft will turn its full attention to the problem. The seriousness of the situation may even cause Microsoft to turn to Unix methods and technologies developed over the years to patch the holes. NT is a robust OS, but only compared to other Microsoft OSes. It can prosper only if it becomes something more. B

Peter Mudge is the chief security architect of LHI Technologies, and Yobie Benjamin is the chief knowledge officer of Cambridge Management Labs, a division of Cambridge Technology Partners, Inc. They spend much research time in the areas of Java, ActiveX, Unix, Windows NT, security, cryptography, and the Internet. You can reach them c/o **editors@bix.com.**

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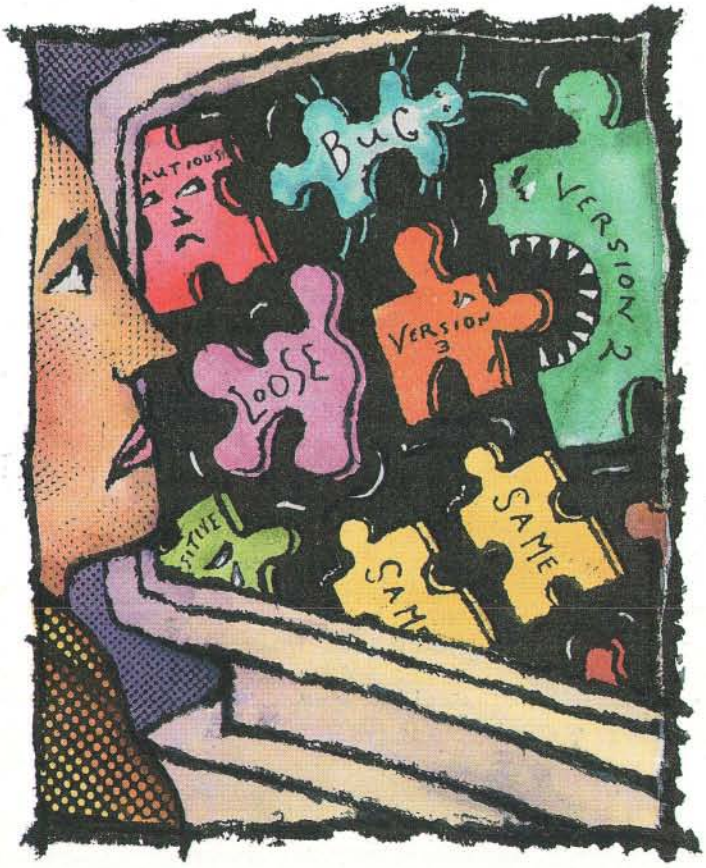
Components Battling Components

Everybody's doing components on the desktop these days, but what are the components doing to the desktop?

By Robert Richardson

When it comes to software components, simplicity is everything. It's not that these items—such as DLLs for Windows and extensions in the Mac world—can't do fiendishly complex things. These mix-and-match software plug-ins can range from simple buttons on Web pages to full-blown chart packages that you can toss into your enterprise database. However, the environment that these parts and pieces inhabit has to be homey if a thriving marketplace for them is to emerge: It should be obvious how to add these components to an existing system. After all, what's the point of having components if it takes an advanced degree and as much as a year of coding to get a few of them to communicate with each other?

The computer industry came to realize the value of no-frills practicality after the hothouse growth in third-party controls (known as VBXes) for Microsoft's Visual Basic. Since then, Microsoft has jettisoned righteous abstractions, such as inheritance and polymorphism, which are sacred to the serious object-oriented-programming crowd. The result has been a shower of derision from the gallery—and a ground swell of support from the vendors and users in the trenches.



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DLLs Aren't Dull

Today, the locus of Windows component development is the shared DLL. This isn't surprising; developers want to be able to share functions without having to share code. This basic functionality is something that DLLs have provided within Windows since the get-go.

There is a problem, though: The wide variance in the structure and syntax of procedure calls within DLLs inhibits the broad use of disparate DLLs. So, increasingly, the Component Object Model (COM)—Microsoft's framework for encapsulating the variations within components behind rigidly defined binary interface entry points—has become a popular way of packaging the components stored within DLLs. COM makes component use easier through two technologies: OLE provides the standard approach to binary interfaces, and the COM "bus" hides the complexity of finding and loading components (even when those components are to be loaded on remote machines).

Much of the success of components on Windows desktops has been due to the success of DLLs. At the same time that DLL use has grown swiftly, however, a troubling pathology of system instability has emerged. In the pursuit of simplicity, Microsoft has overlooked management mechanisms needed to prevent component chaos. The flood of DLLs in a Windows system directory (several hundred on an average Windows installation) is impossible to manage properly. Microsoft seems to be only barely aware of what action it will take to keep components safe for end-user consumption.

Extension Tension

Most component screwups today are on Windows desktops, but that's not because other systems are any cleaner. Rather, the popularity of Windows and the frenzy of shared DLL development have combined to make Windows the de facto test-bed for the desktop componentware concept.

Apple's Mac OS has a limited concept of shared components: Mac OS extensions. These extensions load extra functions into the general OS environment rather than loading and unloading them on a per-application basis. But they do not lend themselves to easy reuse by other applications and, as a result, have not been an active development area. As John Landwehr, product mar-

keting manager for Apple's forthcoming Rhapsody OS, puts it: "There aren't many components in the Mac OS, and I would not say that they're the easiest to use."

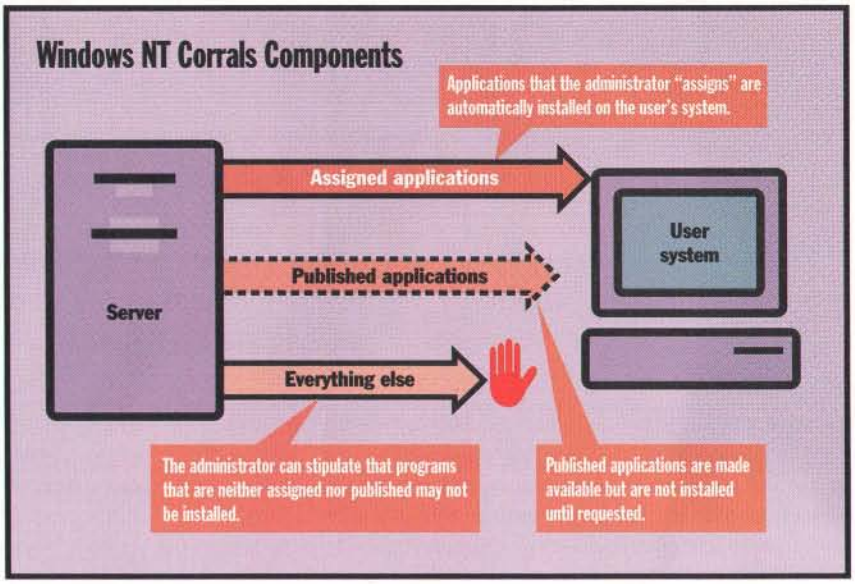
Landwehr adds that extensions are mostly for situations requiring device-driver software, and that applications generally use only the extensions in the application package. Yet Mac extensions often conflict with each other. This has spawned a market for third-party extension managers, such as Conflict Catcher (Casady & Greene, Salinas, CA), and the Extension Manager in more recent versions of the Mac OS. These utilities give users much finer control over when and in what order extensions load. If Mac applications shared extensions more often, as Windows applications do, Mac users would encounter the same array of disasters that Windows users face daily.

Jeff Foster, president of Mac software developer Vicious Fishes Software (Brea, CA; http:// www.viciousfishes.com), says that, as a way to add functionality to serial ports and other hardware, the extension mechanism is "worth the aggravation of most of the conflicts." But there are conflicts aplenty. "Since we're a development shop here, we are continually having conflicts of one sort or another," he adds. "You either find a workaround or let the machine keep crashing."

The original Apple strategy was to leave extensions as just that—extensions to the low-level OS—and then embrace OpenDoc, a multivendor component-software initiative, as a way to deliver componentware on the Mac. But OpenDoc never gained widespread user support, and Apple abandoned it earlier this year.

For now, extensions are the only mainstream component mechanism that the Mac OS has to offer. Since most vendors don't use extensions from third parties, relying on some other developer's extension—the Achilles' heel of DLLs—is not the problem. However, extensions share a common memory space, and one extension's bug is often another extension's corrupted data.

Apple's Technical Information Library is full of helpful tidbits like this: "You can attempt to remedy a conflict by changing the loading order of a given extension or Control Panel by locating the file in the System Folder and adding a space or spaces to the front of the file's name." In other words, you can use the alphabetical ordering of the extension filenames to shuffle around the order in which extensions load. The goal is to mix things up enough so that whatever memory sins being committed are happening in some location where no one gets hurt.



NT 5.0 can lock down a user's System directory, install assigned applications, and allow published applications—but that's all.

Aspirations for a higher level of rocket science have spawned a market for the aforementioned third-party extension managers. They give users much finer control over when and in what order extensions load, generally by copying extensions in and out of the folder from which the Mac OS loads them.

This system might be OK for genuine OS extensions. But as a basis for components similar to DLLs (which is what Mac extensions have gradually become), it's a ludicrous approach, and Apple has done next to nothing to make the arrangement better. As of the 7.6 version of the Mac OS, you don't have to load all your extensions at the same time, but you do have to reboot every time you want to change extension sets. This is *not* one of those situations where Mac loyalists can gloat over how long it took the Windows camp to figure out how to do it right.

Apple's use of components will change radically with the introduction of its new Rhapsody OS, a heavily object-oriented, high-end, "next-generation" product scheduled to be in a developer release by the time this article sees print. Rhapsody, built from the foundations of the NextStep OS, has a highly developed object framework and at least the beginnings of a system for managing it (see the screen on page 94). It remains to be seen whether Rhapsody will have the same component confusion that Windows now has, but it seems possible. Since the simpler Mac OS has extension-conflict problems, Rhapsody may well have even more.

DLL Dilemmas

DLL discomfort has several causes. For example:

Older DLL versions copy over the "correct" versions. This "back-revving" happens because vendors never know whether a customer's system is going to have the necessary shared DLLs. So, DOESGOOD .DLL version 2 goes into the Windows system directory, obliterating version 3 of the same name. To be sure, vendors distribute the DLLs they've tested during development. However, newer drivers may already have superseded these by the time users load them.

In theory, a vendor's installation routine should double-check to see if a newer version of a shared DLL is already on the target system. Yet vendors have been sloppy or cautious about this, depending on how you look at it. On the sloppy side of the equation, some installation routines simply don't check for existing DLLs. In the interest of caution, though, some vendors intend to copy the specific DLL that they've tested, which gives them some cause for confidence (in particular because they're worried about the next DLL

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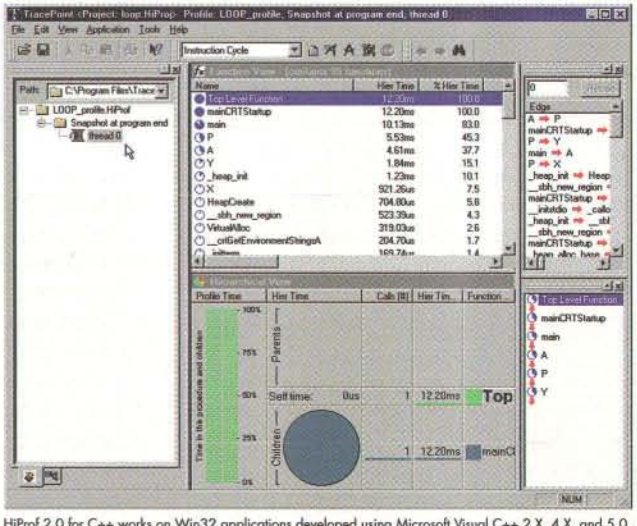

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discomfort I'll discuss). Copying older DLL versions means the newly installed application will work, but applications that rely on later versions of the DLL are now more likely to encounter problems.

Users can also get in on the fun by, for example, restoring files from backup tapes without regard for newer versions installed in the meantime.

Newer DLL versions copy over older versions. The heartening, if perverse, optimism of the software industry makes us believe that an updated version of a component will be better than older versions. But new versions introduce new bugs or don't speak the same interface language as older versions. So when a vendor follows the rules and does not load an older DLL, it can get into trouble for adhering to Microsoft guidelines.

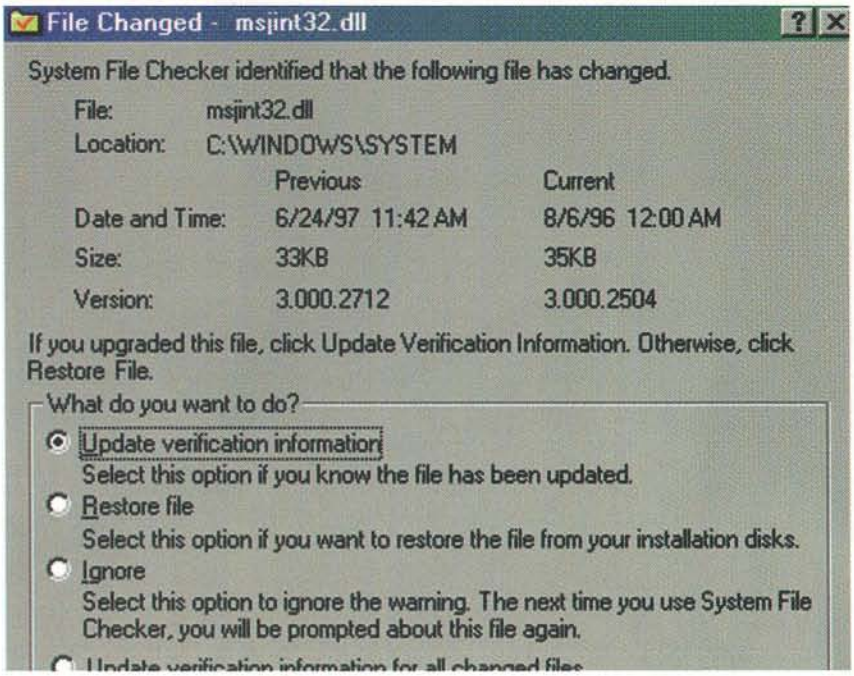
If you load a new copy of Microsoft's Publisher 97, for instance, the installed program may fail immediately after it starts. The Microsoft Technical Support KnowledgeBase boldly states that "this error occurs if a newer version of the MSVCRT40.DLL file is already installed on your computer when you run Publisher Setup." This is your reward for keeping up with Redmond's product line.

The system deletes shared DLLs during uninstalls. When an application installs itself according to Microsoft guidelines, it increments registry-based usage counters for all the shared DLLs it calls. When Microsoft's uninstall feature removes programs, it consults the counters to see how many other programs expect the shared DLL to be there.

If no other applications need the DLL, the system will assume it's OK to remove the DLL. But nothing forces applications to increment the counters. If one program shirks its duties, the counter is off, the DLL may well vanish prematurely, and thereafter any programs that need the DLL are bound to fail.

Windows keeps hidden copies of special DLLs that you cannot delete. Windows keeps copies of some particularly sensitive DLLs in the SysBckup directory within the Windows directory. At startup, it compares the copies to the originals in the System directory and, if they don't match, the backups copy over whatever's in the System directory. Copying a new version of WINSOCK.DLL into the System directory, for example, will be magically undone at the next system start-up.

DLLs can conflict with each other. Some DLLs are just plain badly coded, a simple fact of programming life. While we're all resigned to a certain amount of buggy code, it would be desirable to be able to separate contentious DLLs so that they never load at the same time.



A report generated by Microsoft Windows 98's System File Checker, indicating that a system-level file has changed somehow.

This is an instance where the Mac has created advantage from adversity. Unlike DLLs, which load as needed, Mac extensions load into memory and stay there throughout a session. In earlier versions of the Mac OS, all the needed extensions had to load, meaning that they all used memory all the time. When conflicts occurred, the only remedy was to juggle the order in which the extensions loaded. Version 7.6's Extension Manager could create different groups of extensions so that some would load together while others would not.

The DLL namespace readily allows collisions. Vendors currently tend to throw all their DLLs into the System directory, although Microsoft suggests that only shared DLLs belong there. Further, even though Microsoft's 32-bit OSes allow DLLs to have long filenames, most vendors stick to the 8.3 convention; they must if their DLLs are also for 16-bit environments. Plus, their files may someday reside on a shared network drive that supports only short names.

There are only so many eight-character names—fewer when you use meaningful abbreviations and short words. When two developers use a name like DISPLAY.DLL, somebody's going to get hurt.

DLLs may not load the way Microsoft says they do. Dan Plastina, group program manager for Windows administration, says Microsoft's 32-bit platforms load DLLs "by path name, not by filename." He says there is not a problem if they call two DLLs with the same name if they have unique full path names.

Not so, say programmers, including John McMillan, lead programmer for new product development at Great Lakes Business Solutions (Canton, MI; http://www.glbs.com), which makes the installation product Microsoft now uses for its System Management System product. "Once a DLL is in memory, the system will never pull in another version of that DLL again," he adds. Other programmers cite cases where Windows has mistakenly used a same-name DLL.

The issue seems to arise because there are two ways in which a DLL can load. In a normal case, it uses a link library of *stub functions* (i.e., the same process compiles the actual DLL) and calls the DLL by its short name. Windows checks memory for currently loaded DLLs of the same name before looking elsewhere. It's possible to load a DLL by path name, but only

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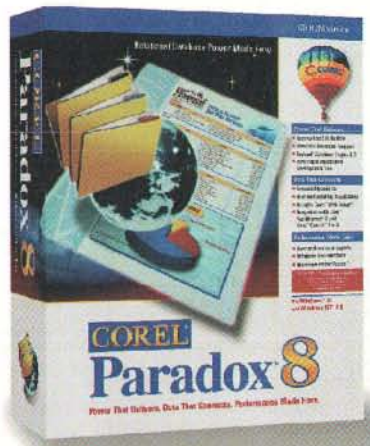

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when you make DLL function calls by linking to a library of precompiled stubs.

DLLs with the same version number may be different. Each DLL has a version resource that includes several stock fields, including a binary version number and a string for the manufacturer. You can see the version number for a DLL by right-clicking your mouse on the file within File Explorer and then selecting Properties. But there's no standard rule for updating these numbers. It's common practice at Microsoft, for instance, to release several different builds of a DLL with the same version number.

This last problem—different DLLs with the same version number—has some independent software vendors (ISVs) hopping mad. Bob Denny, creator of O'Reilly and Associate's WebSite, says the root cause of "DLL hell" is what happens when you have "a component where the behavior hasn't been changed but that's been bug-fixed. Microsoft itself has in some cases released dozens of versions of a DLL that are functionally identical but that have different levels of bug fixes."

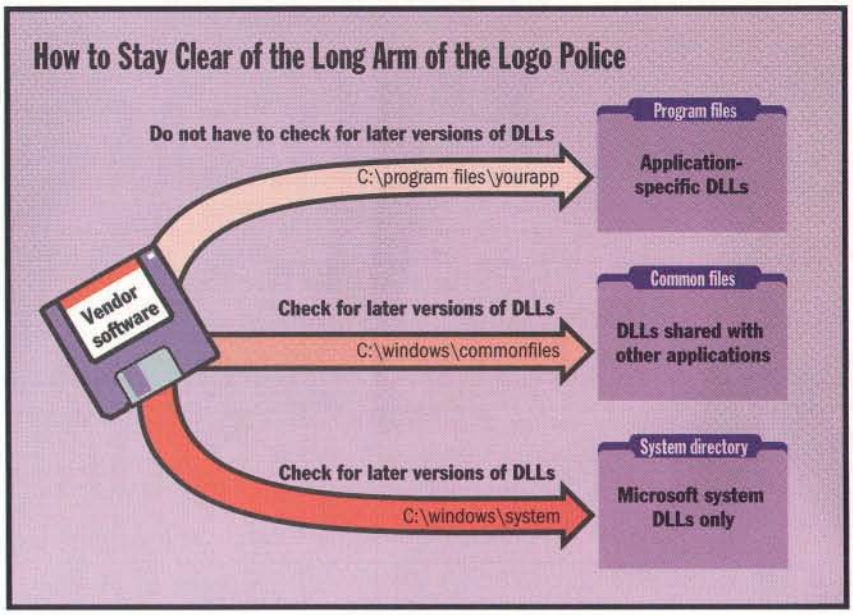
Moreover, end users are often unaware that underlying system-level components have changed. Loading something like an Internet Explorer browser update can update low-level OS components—the lowest-level TCP/IP protocol stack DLLs, for example. There may be no direct relation; Microsoft may have used the update to slipstream a number of OS patches.

The result is that it becomes harder for vendors to support their products because it's difficult to tell exactly what set of system DLLs any given user has. "As a developer," Denny says, "I really hate working in the Microsoft environment right now, because it's just a snake pit from a support standpoint. You never know what your customers have."

How Active Can One Desktop Be?

Developers are making two separate realizations about desktop components. The first is that haste makes GPFs. Microsoft's rush to get activated has resulted in too many versions of system components that beg for stability. Vendors have been sloppy, too, with shared components in the System directory.

The second realization, though, has consequences that require more than tie-straightening and good manners: Applications badly need a way to protect themselves when forward compatibility with new versions of trusted components does not work out. There's a new realization that better tools are necessary for assessing component conflicts. It's sometimes more stable if developers reuse components in their products but don't try to share them with other applications on users' systems. Much more stability is necessary in widely shared components, such as the 3-D controls in Office, FrontPage, and Internet Explorer (all now shipped with slightly different versions).



Good behavior includes steering application-specific, common, and system-level DLLs into the proper directories.

The Microsoft Way

Microsoft realizes there's a problem, says Russ Madlener, product manager for desktop OSes. However, don't look for any real fixes to come with Windows 98 (aka Memphis). Help will come in the form of somewhat-better safeguards for DLL installation and a tool for post-mortem forensics on failed systems.

First, Microsoft intends to get tougher about granting "Designed for Windows" logos to software vendors. Madlener says there will be "enhanced restrictions" on the "whole approach of installing and uninstalling an application." To date, he says, Microsoft has offered only guidelines, which often are not well understood or followed.

Under the new program, vendors will be in "violation of logo" if they copy anything other than Microsoft-shared DLLs to the System directory (see the figure "How to Stay Clear of the Long Arm of the Logo Police" above). Components intended to be shared by others will be copied into the Common Files directory. Every other DLL that an application uses must be in the application's own directory. Assuming vendor compliance, this will at least reduce the risks of name collisions.

Coming with Windows 98 is the System File Checker, which performs such an obvious function that one wonders why it wasn't available before. This utility checks system-level files—and any other files that the user wants to monitor—to make sure they haven't been modified or corrupted since the last time the utility recorded a profile of the system (see the screen on page 90).

NT Promises

It's with the release of Windows NT 5.0 that component-management enhancements really get interesting, according to Madlener. For one thing, vendors will no longer control their own destiny when installing a new application. Instead, installation will pass to a system-level installation utility. Currently code-named Darwin, this setup utility will run on all 32-bit platforms.

With NT, says Microsoft's Plastina, "when you go to install an application, you ask Darwin to do the work for you. You give Darwin an instruction file." Dar-

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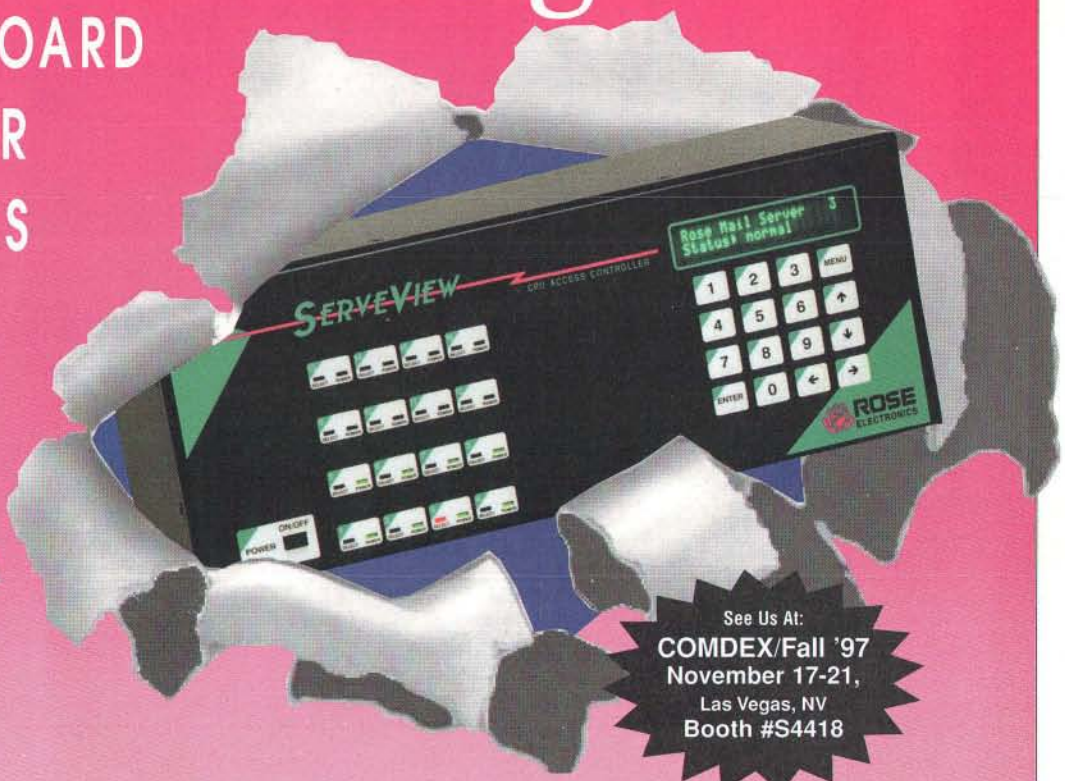

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Rhapsody manages objects in three folder tiers: for user and system on each system and, here, for the system object folder on the server.

win carries out the instructions, following the rules of DLL reference counts and replacing DLLs.

Another change in DLLs has to do with packaging system components. Says Plastina: "Today when you install an application, it puts down a good number of megabytes of data that comes with the system. Those are really OS components, though. With NT 5.0, we'll have quarterly releases of shared component service packs." These will contain "the latest versions of the DLLs that the OS group has blessed, and applications won't ship those DLLs anymore." DLLs in service packs will contain updated version numbers.

Darwin is just one part of the Zero Administration Windows (ZAW) initiative that Microsoft announced a year ago. Network administrators will also be able to lock down the Windows directory so that a user can't change it (see the figure "Windows NT Corrals Components" on page 88). In addition, administrators will have complete control over which programs go on a user's system.

Future Perfect?

To some degree, mismatches among components are an inevitable result of the current pace of software development and the modular approach to software that's necessary for updates in short time frames. But there's now concern among some developers that Microsoft's game plan of migrating most components from plain DLLs into the COM framework might only make matters less manageable. If the problem of DLLs is a lack of control over versioning, the problem with COM is that the whole notion of versioning is absent.

In COM, the functionality of each interface is specified and permanently fixed. Every interface is assigned a Globally Unique ID (GUID), which virtually eliminates name collisions. But individual implementations of the interface associated with any given GUID are indistinguishable within COM.

For now, Microsoft has implemented most of the widely used COM interfaces. Furthermore, until now, fixing Microsoft's COM interface bugs has entailed adding functionality; each revised interface has received new function calls and new GUIDs.

Despite prior insistence that the interface is all that matters, Microsoft's Madlener says that there are "plans to add finer-grained versioning to COM." The details of versioning in the next generation of COM (called Common Object Runtime [COR]) should be out by the time you read this.

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There are similar promises on the Apple front. Rhapsody gets the benefit of several years of Next's experience with objects. Unfortunately, Rhapsody objects don't have versioning, either. Apple's Landwehr says that Apple is "planning on making some changes this fall that will support better object versioning."

There's no question that careless vendors will always be able to crash systems with badly done software. At the same time, though, mainstream OSes need to provide at least a rational safety net when third-party component vendors take reasonable pains to behave.

Right now, the Windows desktop has arrived at a critical point where things are falling apart and more control is necessary. Other OS vendors—who haven't faced the fire that a base of 40 million users can ignite—should examine whether their own component-management strategies will hold up under heavy use.

There are certainly steps that users and vendors alike can take to limit the depths of DLL hell. Vendors need to tighten up their installations so that only system-level DLLs (generally, those made by Microsoft) load into the System directory. DLLs for general sharing among multiple vendors should load into the Common Files subdirectory. All other DLLs go in the application's own directory. Shared DLLs should change only when a newer version of a component replaces an older one. Even then, the user should receive notice of the replacement and have the option to back up the DLL being replaced.

Users should use the Windows 98 System File Checker utility to ensure that older versions do not replace newer System files when new applications load. It would be a creditable gesture for Microsoft to freely distribute this utility to current Windows 95 users as well.

Meanwhile, because Windows is by far the mostly widely distributed desktop platform that employs component technology, Microsoft should embrace the long-term task of straightening up the mess. Usable componentware hangs in the balance. B

Robert Richardson (Swarthmore, PA) is a frequent contributor to Network Magazine, Web Review, Web Techniques, *and* ZD Internet. *His latest book,* Building Your High-Tech Small Office, *is forthcoming from IDG Books Worldwide. You can reach him by sending e-mail to* **robert@smallofficetech.com.**

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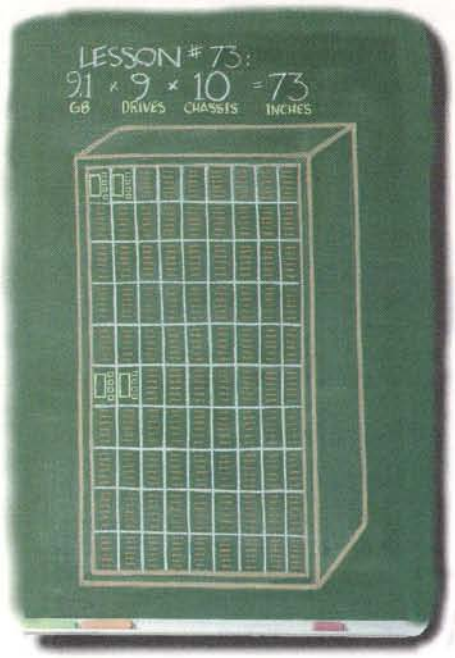

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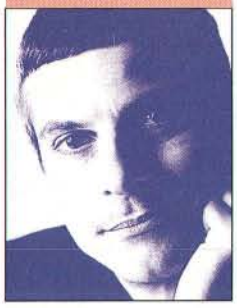
Jon Udell

Web Project



Cascading Style Sheets

CSS will change the way Web designers and developers work. Here are some practical ways to learn and apply it.

HTML purists say that the markup language, like SGML, expresses only the structure of documents. The browser—not the author—controls presentation, because only the browser knows best how to adapt content to exploit the capabilities and workaround constraints of its host system.

The reality of HTML is quite different, of course. There's intense pressure on publishers and software developers alike to control the look of their Web pages. We do this with bastard HTML tags, such as <FONT> and <CENTER>; with nested tables; and with nonbreaking spaces and invisible GIFs. By resorting to these hacks we achieve the necessary effects, but we also trade away universal access and easy maintenance.

CSS purists say that style sheets influence, but do not absolutely control, the presentation of documents. Author and reader can share influence, and the rendered page is a negotiated compromise. Non-CSS browsers can fall back to vanilla HTML, which remains the skeleton of any CSS-enhanced page.

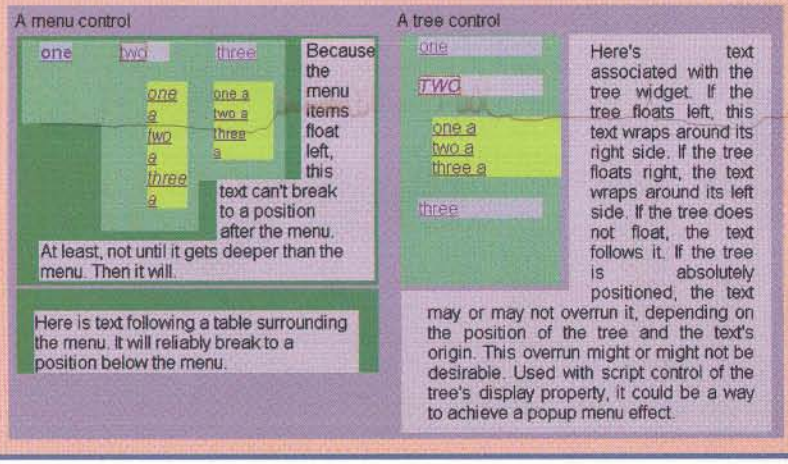
The reality of CSS will likely diverge from the ideal, just as HTML has, for the same reasons, involving the same tradeoffs. With HTML, I'm always looking for the sweet spot—the right balance of purity and pragmatism. Because that's a moving target, I continually adjust my pages and applications to track it. So with CSS.

What's the sweet spot for CSS right now, with immature support for style sheets in the 4.0 browsers from Netscape and Microsoft? What's it likely to be in eight months when CSS implementations are more complete, widespread, and reliable? Here are some answers, and some educated guesses.

PHOTOGRAPH: KELLIE WALSH © 1997

HTML + CSS + JavaScript = Dynamic HTML

Here's a lightweight approach to active content. In this demo, every list's title (i.e., one, two, three) is wired to a JavaScript function that toggles the CSS display property of the corresponding list. When you set the display property to "none," the browser hides the list and reflows the document to reclaim its space.



CASE 1: An HTML/JavaScript/CSS Slide Show

When I give presentations nowadays, I use Web pages for slides. Modifying style across a set of slides always used to be a problem. If you used embedded HTML tags, such as <FONT>, you had to do a global search-and-replace across multiple files to change the look of a presentation consistently.

CSS neatly solves this problem. Now when I create a slide show, I clone pages from a template that includes a reference to a style sheet. The style sheet contains a series of directives, like this:

```
body { font-family: arial; }
h1 { font-size: 24pt;
     font-weight: bold; }
```

In this example, CSS defines the default font, and the size of <H1> headers, for every slide. Technically, CSS merely influences these matters, subject to the counter-influence of the user's style preferences. In practice, that won't happen much until browsers support user style sheets and users learn to apply them.

There's a lot to say about these rules. The `font-family`, for example, might better be requested like this: Verdana, Arial, Helvetica, MS Sans Serif. Proceeding from specific to generic, this list equips the browser to use the author's preferred fonts when available (in order of preference) and authorizes the browser to fall back on a generic sans serif font if necessary.

continued

Likewise, the `font-size` might better be expressed in one of these ways:

```
h1 { font-size: larger; }
h1 { font-size: 200%; }
h1 { font-size: x-large; }
```

Almost everything in CSS can be expressed using abstract terminology that's relative (`larger`, `200%`) or absolute (`x-large`). Relative mode makes an element vary in proportion to other elements; absolute mode makes an element independent of others.

Why `x-large` rather than `24pt`? Because 0.33 inch (24 points divided by 72 points per inch) might be too small to say "extra large" on a high-res workstation, but overwhelmingly large on a PDA. `x-large` requests an absolute size, but one that can still be interpreted in a device-appropriate way.

The `h1` headers use the body's `font-family`, although the `h1` rule says nothing about `font-family`. Why? `h1` inherits from `body`. If you're familiar with style sheets in conventional word processors, it may take a while for you to get the hang of this. CSS inheritance is a powerful mechanism. To exploit it requires a mind-set that owes more to object-oriented programming than to desktop publishing. The challenges—and the rewards—are similar.

A Dose of Practicality

When I added a table to one of my slides, I ran into a snag. The table didn't inherit my `font-family` request. Why not? Navigator 4.0's CSS support is very shaky; inheritance across table boundaries is one of many things that just don't work. Microsoft Internet Explorer (MSIE) 4.0 (currently in beta 2) works properly in this regard, and in general it's far better than Navigator 4.0. It's a second-generation effort for Microsoft, which committed early to CSS with support in MSIE 3.0. Netscape resisted for too long, and it now finds itself in catch-up mode.

What to do? Because I'm the only one giving my presentations, I could use MSIE 4.0 and just ignore Communicator's CSS flaws. But I don't want to just show my presentation; I want to put it on the Web so that others can view it. Requiring MSIE 4.0 won't do. I'd rather build something that works with both browsers. It's frustrating to look for workarounds, but that's the lot of the Web author. Better my frustration than the reader's. In this regard, CSS is going to be a déjà vu experience.

CSS is enormously flexible, so there are lots of different ways to work around problems. To switch my table cells to an alternate `font-family`, I first tried this:

```
td { font-family: monospace }
```

But the preamble that my JavaScript code inserts into every slide builds another table containing navigational icons and a title. The rule shown above sets every table cell in monospace type; I want only certain tables to be handled that way.

CSS offers a variety of solutions. Here's one: You can make a new class out of any element by adding a class attribute to its HTML tag, like this: `<td class=BodyTableCell>`. Then you can address the set of elements so tagged, as follows:

```
td.BodyTableCell { font-family:
  monospace }
```

This works. But it's stupid to add a class attribute to every cell. You might as well just say `<td><font face=courier>`—just the sort of brute-force redundancy that CSS is supposed to abolish. Here's another idea:

```
<div class=BodyTable>
<table>...</table>
```

continued

Anatomy of a Web Slide Show

Here's a simple JavaScript technique for controlling a Web-based slide show.

1. Clone blank slides from this template:

```
<head>
<link rel=stylesheet type="text/css" href="style.htm">
<script src="script.js"></script>
</head><body>
```

Note: Navigator can source the script from an external file, as shown here; MSIE (including version 4.0, beta 2) cannot.
The style sheet standardizes the look of the presentation; the shared script controls navigation and presents numbered titles.

2. Store the filenames and titles of the slides in a JavaScript array.

```
var docs = new Array (
        'overview.htm|BYTE Site overview',
        'archive.htm|BYTE Site: archive' )
```

3. Treat the array like a Perl or Java hash (a table of name/value pairs).

```
function itemFromDocs (type,i) {
if ( i < 0) i = 0;
if ( i > docs.length-1) i = docs.length-1;
var str = docs[i];
if (type == 'url')      // get the URL
  return str.substring(0,str.lastIndexOf('|')); }
else                    // get the title
return
str.substring(str.lastIndexOf('|')+1,str.length);
}
```

4. Remember the current document.

```
var href = document.location;
var curr = href.substring
  (href.lastIndexOf('/')+1,href.length);
```

5. Compute the hyperlink for the next or previous document.

```
function getLink(which) {
for (var i = 0; i <= docs.length-1; i++) {
 if (curr == itemFromDocs('url',i)) {
   if (which == 'next') { // next slide
     link = itemFromDocs('url',i+1);
     gif = "next.gif"; }
   else {               // previous slide
     link = itemFromDocs('url',i-1);
     gif = "prev.gif"; } } }
return '<a href=' + base+link + '><img src=' + gif +
  '></a>'; }
```

6. Emit a page header that includes the slide's title, plus Previous and Next links.

```
document.write('<table width=100%><tr><td> +
  getLink('prev') + '</td><td>' + showTitle() +
   '</td><td>' + getLink('next') + '</td></tr></table>');
```

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In CSS you can use two new HTML elements—DIV and SPAN—as metatags that group and classify other elements. DIV defines a *block element* (anything bounded by line breaks); SPAN marks an in-line element. In this case, the class attribute on DIV defines a class called `BodyTable`. Now a single wild-card rule, like this:

```
.BodyTable { font-family:
  monospace }
```

can influence all the `td`s contained within instances of that class.

Was this the solution? Nope. It requires inheritance, which, as you'll remember, doesn't work properly with tables in Navigator 4.0. Fortunately, CSS has another trick up its sleeve. You can select sets of elements not only with attributes (`td`, `BodyTable`) but also with contextual patterns of attributes. Here is what finally worked:

```
div th, div td  { font-family:
  courier; }
```

This says: "Apply courier to TH and TD elements, but only those contained within a DIV." I wrapped the tables that I wanted to match this rule in a `<div class=BodyTable>...</div>` tag.

Note that it would have been enough simply to say `<div>`—the new class `BodyTable` isn't contributing anything to this solution. I left `BodyTable` in, though. It won't cause problems with CSS or non-CSS browsers. And it's extra information that might come in handy. Someday I may want to select only the elements that match `BodyTable`, rather than a more general set that matches `div th, div td`. Or, in a non-CSS context, I might want to use a Perl script to extract and catalog or rearrange all the tables of that type.

Even if you have no immediate need to influence presentation with style sheets, there are compelling reasons to adopt the CSS method of classifying content. Class attributes do more than lay the foundation for stylistic control of your pages. They can also provide new hooks for managing your content. Document collections are text databases. Class attributes are selectors that operate on these databases. CSS uses these selectors, but other applications can, too. The value of your text databases grows in proportion to the number and specificity of the selectors you can apply to it.

CASE 2: BYTE Home-Page Redesign

A recent redesign of our home page gave me the chance to try out the design and layout capabilities of CSS-enhanced HTML. Our requirements included a variety of static and dynamic elements of various shapes and sizes, all with fixed locations. There's only one way to do this in straight HTML. You wrap everything in tables. CSS offers two other approaches: floating elements and absolute positioning.

Because I'd have to deploy to non-CSS browsers, I started with a table-based approach. Even in this context, CSS can be useful. If you classify elements, you can rapidly evaluate a series of alternate treatments. The family, size, weight, and color of fonts; the alignment, indentation, line spacing, and margins of text; and a host of other stylistic variables are easily twiddled.

Depending on your inheritance scheme, you can adjust these things for the whole document tree or for selected branches. Once you settle on a design, you can translate your CSS rules down to the per-element tags required by straight HTML.

The next thing to try was floating elements. HTML authors use the FLOAT attribute of the IMG tag to force images left or right and to flow text around them. CSS generalizes the float property. Any block element—image, list, DIV—can float. In theory, you can use this technique to build a page that has a 2-D look but that adapts gracefully to narrow displays. In practice, CSS can do this effectively only in simple cases (see the screen on page 97).

The inventors of CSS are talking about extensions that will make it a full-blown layout system, but in its current form it isn't one, nor does it pretend to be. Still, the float property is powerful. You can, for example, apply it to a group of elements wrapped in a DIV tag. The effect varies according to the other properties of the DIV (e.g., absolute or relative width, left or right alignment), the properties of the other elements in line with the DIV, and the properties of the DIV's container. It's worth spending some time to sort out all these interactions.

Finally, I tried a version of the home page that uses absolute positioning. With this CSS extension, which is supported in both 4.0 browsers, you can place any element at a precise pixel offset from the top-left origin of the page. It's an all-or-none method because elements positioned in this way will never flow, and any other elements that are allowed to flow are liable to overlap the fixed ones. However, normal flow still occurs inside fixed elements.

Using this technique, I tiled the surface of the page with my major elements. The result was pleasing because, unlike a conventional table treatment, the CSS version didn't have to align elements on a grid. This freedom costs something, of course. Tables can stretch if you express their widths in percentages. A page whose elements stand in fixed relation to the origin cannot stretch.

I like this last version best, and I plan to translate it into straight HTML for deployment. Here's hoping that widespread adoption of CSS will make that ugly procedure unnecessary when our next site redesign rolls around. B

Jon Udell is BYTE's executive editor for new media. You can reach him by sending e-mail to **jon_u@dev5.byte.com.**

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ColorPicker
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Robert Hess
http://www.microsoft.com/workshop/design/safety/colorpick-f.htm
Here's a handy reference to the "safety palette": the 216 colors that look about the same on all browsers and all platforms. If you're experimenting with color using CSS, bookmark this page.

BOOKNOTE

Cascading Style Sheets: Designing for the Web

$29.95
by Håkon Wium Lie and Bert Bos
Addison Wesley Longman
IBSN 0-201-41998-X
http://www.awl.com/css/
This definitive guide, written by the inventors of CSS, covers typography, layout, color, element classification and selection, and inheritance. One invaluable chapter shows how to reinterpret basic HTML page designs using CSS.

Rick Grehan

Javatalk

An Uncertain Discovery

Metrowerks' Discover Programming provides a decent introduction to Java code, but it has some annoying inconsistencies.

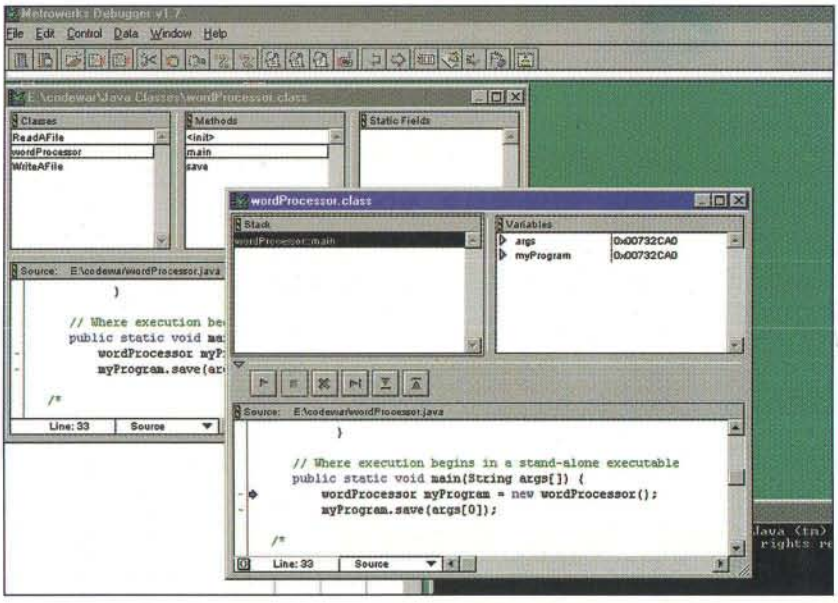
The CodeWarrior Discover Programming Edition (DPE), from Metrowerks, provides a decent multilingual gateway into the world of programming. But if your goal is to become fluent in Java, you may want to look for additional help: Anyone purchasing this set of learning tools should be aware that it's not Java-specific enough to serve as a solid introduction to Java programming.

DPE, which is available for the Macintosh and Windows 95 and NT (I used the Windows version), supports C, C++, Pascal, and Java. The supplied CD-ROM includes version 2.0 of the distinguished CodeWarrior integrated development environment (IDE), plus tutorials, sample code, untold piles of documentation, and seven on-line books.

The entire documentation system is constructed as a Web site. In fact, to enter the documentation system, you have to double-click on an icon named "CodeWarrior Reference WebSite." All the documentation is in either HTML or PDF form. You probably won't need anything else to get going. The CD-ROM includes installable versions of Microsoft's Internet Explorer and Adobe Acrobat reader.

DPE's documentation appears to be spread evenly among all its supported languages, although only one of the seven books (*The Java Programming Language Handbook*, from Coriolis Press) is Java specific. The language and compiler documentation includes both the Java language and Java virtual machine (VM) specifications. More specific to the CodeWarrior IDE is the included *Targeting Java* manual. Finally, the complete Java API and Java Generic Library documents are supplied.

I have two complaints about *The Java Programming Language Handbook*. First, it's in Adobe Acrobat, and navigating through a book in this format can be an annoying pain. The Acrobat reader counts certain elements in a book, such as the cover, table of contents, and prefaces, as separate pages. But the *Handbook*'s table of contents does not. Thus, there's no easy correlation between pages as Acrobat understands them and pages as the book's table of contents understands them.



Metrowerks' Discover Programming Edition includes the CodeWarrior IDE and lot of other goodies for $79.

This is exacerbated by the fact that the book is carved into multiple PDF files—which leads to my second complaint. As a result, the table of contents becomes nearly unusable. For instance, if you're looking for a particular section, you have to guess which PDF file that section is in (and, since Acrobat pages don't match table-of-contents pages, your guess is usually off). The index is equally unusable, having been placed at the end of part 1. (I discovered that by accident.)

Unfortunately, none of DPE's supplied tutorials is Java-specific. A mini-tutorial guides you through the CodeWarrior IDE, but the examples provided are for the Macintosh version. This can be distracting for someone working with the Windows version.

On a more positive note, examples for the *Handbook* are provided as separate, accessible projects that you can easily pull into the IDE. Even though much of the text in the *Handbook* is in 1.0-era Java, the examples provided are updates to the 1.1-level Java Development Kit (JDK).

At the bottom of the HTML link page for the book, you'll find links to each of

PHOTOGRAPH: KELLIE WALSH © 1997

Multiple Java Dimensions

In August, JavaSoft announced the new media and communications Java APIs, of which there are a passel. They include the following:

- Java 2D and Java 3D (which is what I'll focus on here).
- Java sound, including mixing and MIDI synthesis.
- The Java media framework, which deals with (among other things) audio/video playback and videoconferencing.
- Java animation, which deals with 2-D animation.
- Java telephony, which is self explanatory.
- Java speech, which includes speech recognition and synthesis.
- Java collaboration, which deals with data sharing.

I could spend much of the rest of this magazine's pages trying to cover all the APIs, but obviously I don't have enough space for that. Instead, I'll continue my coverage from previous columns, in which I discussed 2-D graphics and VRML, and concentrate on the Java 2D and Java 3D APIs. (You can find and download further information about the other APIs from http://www.javasoft.com.)

Java 2D is actually an extension to the Java Abstract Window Toolkit (AWT). Plans are that it will be included as part of the JDK. The additional classes of Java 2D provide such features as arbitrary fills, tiling, Bézier paths, extended font characteristics (which let you define such font features as kerning, glyph substitution, and ligatures), and a variety of transform operations.

More elaborate elements of Java 2D provide for image-processing operations. For example, Java 2D defines the classes and interfaces necessary for constructing convolution kernels, as well as source and destination image buffers. With the added help of the `ConvolveOp` class, you can easily implement 2-D filter operations, such as blurring, sharpening, edge detection, and so on.

In addition, Java 2D provides greater control over colors. For example, its color-conversion classes provide for converting among RGB, CMYK, gray scale, HLS, HSB, and a half dozen more color spaces (some of whose acronyms I'm not familiar with).

Java 3D (unlike Java 2D) is a "premium" extension to the standard JDK. What that means in terms of availability and distributability is currently unclear. At the time this article was written, JavaSoft representatives were unable to discuss the details of the business model.

Java 3D runs atop standard 3-D rendering engines, such as OpenGL, Direct3D, and QuickDraw 3D. But since it simply depends on the rendering capabilities of such graphics engines, it can run atop "raw" graphics hardware.

Java 3D is a "scene graphics" API. The virtual universe modeled by Java 3D is stored in a complex tree-like structure that's known as a "scene graph" and is composed of connected objects. Some objects in the scene graph define shapes that are ultimately rendered into the things seen in the virtual world. Other objects define textures, colors, reflectivity, and so forth.

One particular object, called the view object, carries the information needed to render the scene. The view object is itself a composite of other objects. For instance, one of its components is the `PhysicalBody` object, which contains information describing the characteristics of the viewer (i.e., the end user). The information is frighteningly detailed, and it's obviously designed to model the characteristics of a human viewer immersed in a 3-D world. Data in the `PhysicalBody` object defines the location of the viewer's eyes—even the interpupillary distance. The idea, of course, is to provide the developer with a framework that has enough richness to capture the widest range of viewing devices.

A unique component of Java 3D is the 3-D sound component. Given that a scene graph includes a view object, the system has all it needs to deduce the location of the viewer and the viewer's relation (in 3-D space) to other objects in the scene. (In addition, the system has information about the geometry of the viewer himself/herself.) This information is used by the sound engine to provide realistic, spatialized 3-D sound with little programmer intervention. If the viewer is close to an object that's emitting a sound, the sound is louder; farther away, the sound is softer.

Finally, even if you're uninterested in 3-D graphics, you should be aware that Java 3D defines a vector-and-matrix math library suitable for general-purpose mathematics programming. These libraries are not part of the Java 3D API per se, although Java 3D depends on them as storage and manipulation classes for data such as coordinates, color information, vector normals, and so on. JavaSoft expects that the members of this library will be removed into a separate java.vecmath package in the future.

the projects. If you click on a link, CodeWarrior copies the project file into the directory of your choice. (It works just as though you had selected a file for an FTP-style download from the Web.) Once the project file is on your system, double-clicking on that file opens the IDE.

Another positive aspect is the included Metrowerks IDE. But be warned: This is a classic editor/compiler/debugger environment. And as good as the compiler and debugger are, there are no facilities for visual applet construction or drag-and-drop frame population.

The system requirements for the Windows version of DPE are remarkably modest. All you need is a 486-based system with at least 16 MB of RAM, Win 95 (or NT 4.0), and a CD-ROM drive. It ran comfortably on my 50-MHz 486. (The Mac version requires a 68020 or PowerPC 601, 16 MB of RAM, and System 7.1 or higher.)

WHERE TO FIND

Metrowerks, Inc.
Austin, TX
800-377-5416
http://www.metrowerks.com

I understand that the rapid evolution of Java standards makes it difficult to keep pace, and I applaud Metrowerks' updating of the examples from the *Handbook*. But updating the examples puts them out of sync with some of the material in the book, and that can be a little confusing.

Metrowerks says that the books provided on the CD-ROM are "previews," and the company recommends that if you find one of the on-line books useful, you should purchase a "real" copy of that book in deference to the author. I agree, but I would add that you should do so primarily to keep your sanity. Dealing with a book in Acrobat form is the antipode of fun.

The DPE is more useful as an introduction to basic Windows programming than Java programming (and, admittedly, this is how Metrowerks advertises it). The DPE is sold as a learning environment; an upgrade for commercial development costs an extra $449. Still, for only $79 you get that great CodeWarrior IDE. Go buy a couple of newer Java books, and you've got a great starter development system. B

Rick Grehan is a senior editor at Computer Design *magazine and coauthor of* The Client/Server Toolkit *(NobleNet, 1996). You can contact him at* **rickg@pennwell.com.**

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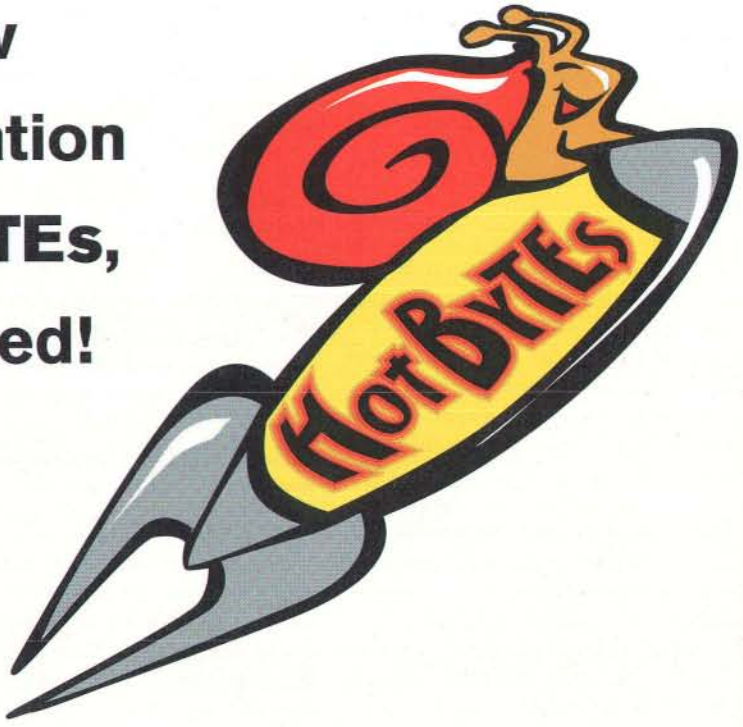

BYTE

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New MMX laptops with 166-, 200-, and 233-MHz processors equal a virtual office desktop replacement.
By Michelle Campanale

26 No-Compromise Power Portables

Picture this: You're 33,000 feet above sea level, packed in your seat tighter than the stuffing in a Thanksgiving turkey. On either side of you are irritable passengers who fight you for the arm rest. Indeed, traveling thousands of miles cross-country is no easy trek. A turbulence-free flight makes it bearable. A high-powered laptop souped up with a 13.3-inch screen, Pentium MMX processor, 20× CD-ROM drive, and 6-hour battery life can make the trip a delight.

Road Rules

True road mavens won't leave home without their trusty laptop. What's more, many people are replacing their aging desktop computers with portable versions with as many bells and whistles. Now, the newest-generation notebooks, powered by Pentium 166-MHz and 200- or 233-MHz "Tillamook" processors, are more capable than their predecessors of becoming true desktop replacements.

We judged 26 portables that hit both ends of the price spectrum, ranging from $2600 to $5700. All employ 166-, 200-, or 233-MHz CPUs. We tested a good sampling of what's currently shipping and chose to focus on 166-MHz nonbeta models with stable drivers. For this roundup, we sought systems that have 166-MHz processors or better, 1 MB or more of video RAM, 32 MB of memory, 2.1-GB hard disk minimum, a maximum of 512 KB of L2 cache, and two batteries. (Reference manuals and user guides were also judged, and they contributed to each system's usability score.) You'll notice a few systems reviewed here don't exactly match that feature list; we wanted to make sure that the most useful configurations were tested, and we note variations where necessary.

Unfortunately, some vendors introduced systems too late for testing, and others fell out for various reasons. We had already reviewed a beta version of the new ThinkPad 770 from IBM (see "The Best ThinkPad Gets Better," October BYTE). The first PC notebook (called the PowerTrip) from former Macintosh clone maker Power Computing was not ready for review in time to meet our deadline. Fujitsu, Nimantics, and Samsung also missed our testing deadline.

BYTE BEST LAPTOPS

Micron TransPort XKE
With its 13.1-inch screen, dual pointing devices, and conveniently located device bay, this is the outstanding 166-MHz portable. It outperformed all other laptops in our tests, and it has strong usability and features.

Gateway 2000 Solo 2300SE
For the price, the Gateway Solo 2300SE low-cost winner is a solid choice. In price/performance value, it bested all other systems tested, and its features set topped all other systems we looked at.

What's Hot, What's Not

Evolving trends in laptop design aren't hard to spot. Support for Zoomed Video and CardBus are common. We also saw some support for MPEG hardware acceleration for playing full-screen video smoothly at 30 frames per second. And designers continue to improve placement of device bays.

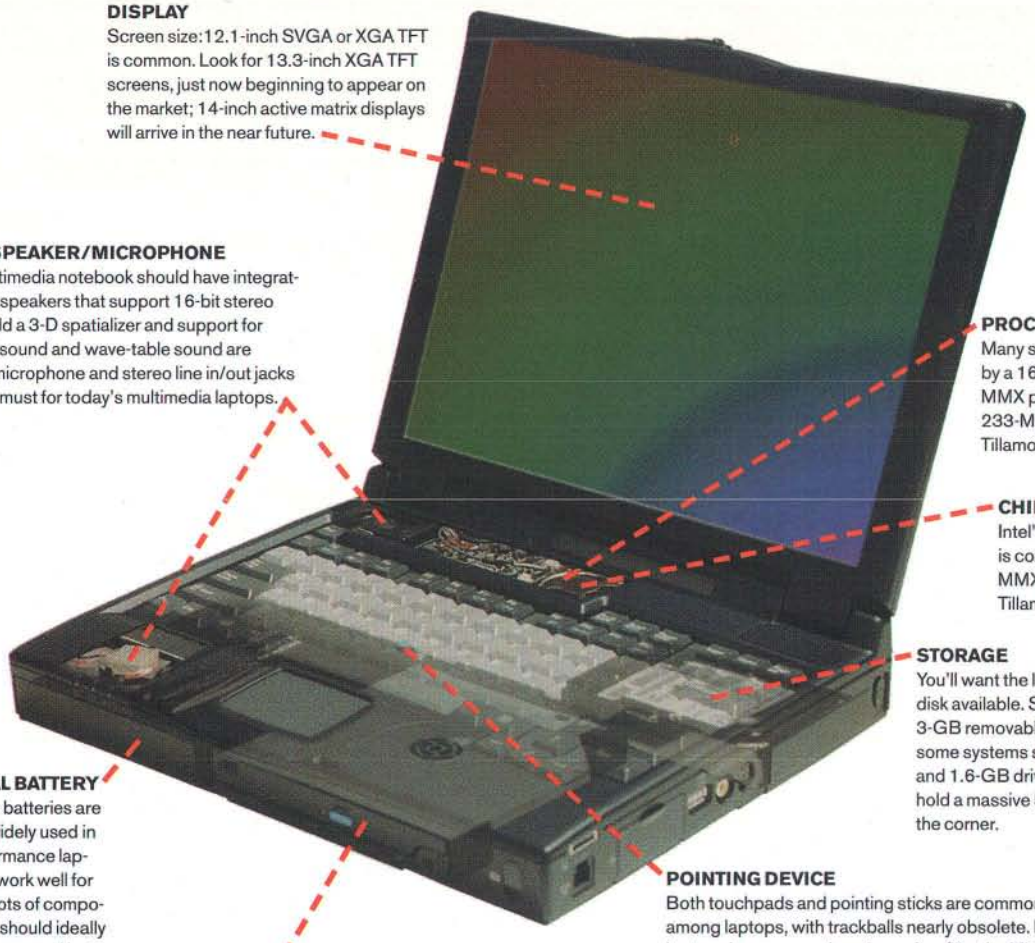
Integrated modems are becoming a standard for high-end notebooks. Additionally, integrated Universal Serial Bus (USB) ports showed up on nearly all the machines we tested. A few systems, like Micron's, include both trackpoint and touchpad pointing devices. Function keys provide access to configuration tools for each pointing device.

A handful of computers we tested had 13.3-inch screens. These could display full-screen, full-motion video. Many of the remaining laptops sported 12.1-inch screens. More than half the laptops in our tests have a maximum internal resolution of 800 by 600. But vendors like Gateway, Micron, Hewlett-Packard, Hitachi, Sony, Sharp, and a few others provided screens that support 1024 by 768 pixels. The Gateway 9100XL supports 1280 by 1024 maximum internal resolution.

In addition to better screen resolutions, other breakthroughs are apparent. A few vendors, like Dell, Micron, Gateway, AMS Tech, Sceptre, WinBook, Eurocom, and Micro International, include huge hard disks with 3 GB of space. On the CD-ROM front, Micron broke new ground by sending in a system with a 20× CD-ROM drive.

233 MHz: Built for Speed

Mobile MMX CPUs running at 200 and 233 MHz, in addition to the existing 166-MHz CPUs, are available in a variety of configurations. The mobile module,



DISPLAY
Screen size: 12.1-inch SVGA or XGA TFT is common. Look for 13.3-inch XGA TFT screens, just now beginning to appear on the market; 14-inch active matrix displays will arrive in the near future.

AUDIO SPEAKER/MICROPHONE
Every multimedia notebook should have integrated stereo speakers that support 16-bit stereo sound. Add a 3-D spatializer and support for surround-sound and wave-table sound are viable. A microphone and stereo line in/out jacks are also a must for today's multimedia laptops.

PROCESSOR
Many systems are powered by a 166-MHz Pentium with MMX processor. Look for 233-MHz processors in Tillamook-powered systems.

CHIP SET
Intel's PCI Mobile 430TX is common for 166-MHz MMX systems and Tillamook systems.

STORAGE
You'll want the largest-capacity hard disk available. Some models have 3-GB removable hard drives, though some systems still come with 2-GB and 1.6-GB drives. Drives that can hold a massive 5 GB are just around the corner.

INTERNAL BATTERY
Lithium ion batteries are the most widely used in high-performance laptops; they work well for units with lots of components. You should ideally purchase a second battery for cross-country travel. Nickel metal hydride batteries are common among low-end laptops. In the near future, look for lithium polymer batteries, which contain lithium instead of cobalt in the cathode.

DEVICE BAY
This housing holds a CD-ROM drive (up to 20x in some models), floppy disk drive, multimedia controls, or spare battery. DVD drives will appear here soon.

POINTING DEVICE
Both touchpads and pointing sticks are common among laptops, with trackballs nearly obsolete. Most laptops have one or the other; a few (like the Micron shown in the illustration) have both.

BACK VIEW

INTEGRATED PORTS
USB, high-speed infrared (one on front, one on back), parallel, serial, VGA, PS/2 (one for external keyboard, one for mouse), game/MIDI port, cellular port, modem port, NTSC and S-video ports.

Illustration based on the Micron TransPort XKE.

ILLUSTRATION: SANDERS/TIKKANEN DESIGN & ILLUSTRATION © 1997

which integrates the Pentium CPU with MMX technology, a portion of Intel's 430TX chip set, and the pipeline burst static RAM L2 cache, powers many of the machines tested. Systems based on Intel's P55C processor can reach speeds of up to 166-MHz only. With Tillamook processors, laptops now reach 200 and 233 MHz.

The first to utilize a 0.25-micron manufacturing process, Intel's Tillamook processors are expected to enhance chip performance 20 percent over their 166-MHz counterparts. In addition, they are expected to consume 40 percent less power than previous high-end mobile processors. Lower battery consumption can accommodate increasingly powerful components, such as high-resolution color displays, 20× CD-ROM drives, 56K modems, and high-capacity disk drives.

As components become increasingly more powerful, the need for longer battery life continues. The 166-MHz systems currently operate at 2.45 volts. Tillamook laptops operate at a core voltage of 1.8. Yet the next generation of laptop components, including 24× CD-ROM drives and 14-inch displays, may negate any reduction of power and heat.

Six of the 26 systems have 200-MHz (or faster) processors. Because these were early prototype or beta units, we chose not to declare one a winner. There are three 200-MHz MMX CPUs in this roundup, from Chem USA, AMS Tech, and MicroExpress. Sceptre, Micro International, and Eurocom were able to send us 233-MHz systems for evaluation.

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BEST OVERALL POWER PORTABLES

We chose the Micron TransPort XKE as the overall winner. It was the performance leader among all the 166-MHz systems we tested. Though it is pricey (it is the third most expensive among the 166-MHz crop), the Micron's superior usability and excellent collection of features more than compensate.

Micron does not skimp on components. The unit includes a 13.3-inch XGA-compatible active matrix display and modular bays for holding either a CD-ROM drive or a floppy drive. The conveniently placed device bay is in the front of the system, beneath the keyboard. Additionally, it has Zoomed Video and CardBus support, a built-in 33.6-Kbps modem, and 20× CD-ROM drive. The TransPort has excellent battery life and two pointing devices (touchpad and stick). It's heavy, however, weighing 7.2 pounds with battery and floppy drive.

Best Value

First place for Best Value notebook goes to the 166-MHz Gateway Solo 2300SE. It has the best price of all systems reviewed. The Gateway's strong performance score bested that of all the 166-MHz systems tested except for the higher-end Micron TransPort XKE and the Gateway 2000 Solo 9100XL. In addition, its usability is better than average.

The unit has a 12.1-inch screen that supports 800 by 600 resolution. Its PC Card connection supports Zoomed Video. And it can house up to 192 MB of memory in three SO-DIMM sockets.

Notable Portables

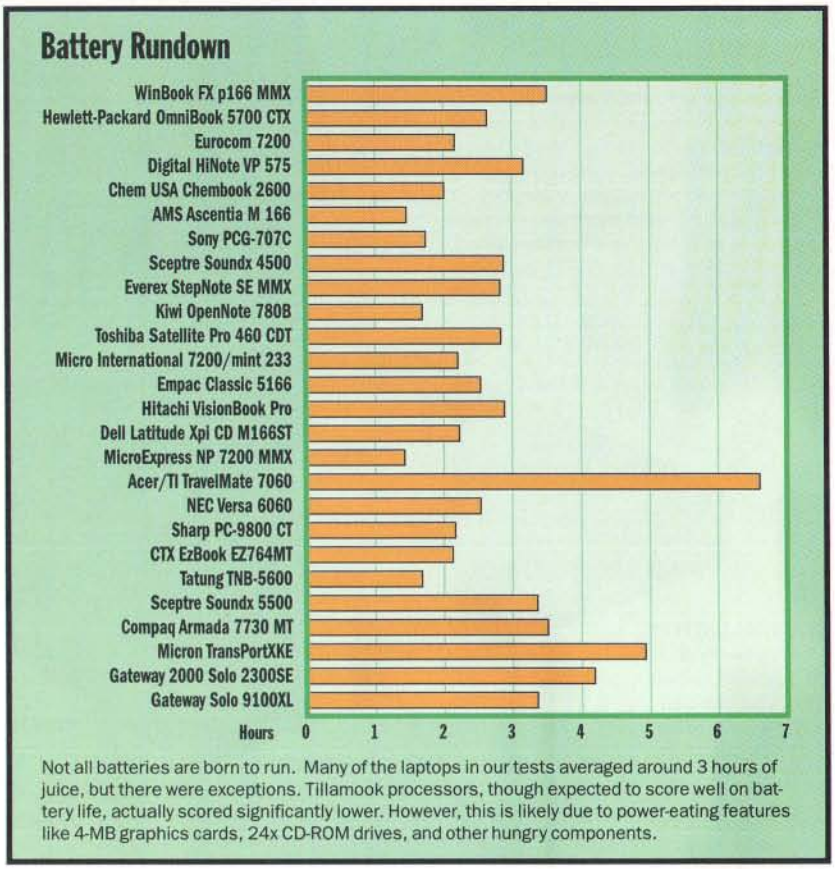
The Compaq Armada 7730MT's outstanding usability rating merits close attention. This model comes with an 8× CD-ROM drive, modular drive and battery bays, and a 33.6-Kbps modem. With a battery life of 3:03 (in our tests), it places in the top third of all systems reviewed. The Armada, a good desktop replacement, also scored excellent numbers in our Excel, Word, and Access applications-based tests.

Another portable worthy of notice is the Acer/Texas Instruments TravelMate 7060. (Acer recently acquired the TravelMate line from Texas Instruments.) It offers very good performance, coming in fourth among all other 166-MHz machines we benchmarked. What makes this system stand out is its long battery life. In our tests, it lasted 6:35, scoring significantly higher than its closest competitor, the Micron TransPort XKE, which lasted 4:72.

A Scattered Mix

Eight vendors sent us speedy machines in either 200-MHz Pentium MMX or 233-MHz Tillamook configurations. Those vendors who sent in 233-MHz machines were Sceptre, Micro International, Eurocom, Toshiba, and NEC. The 200-MHz systems were sent in by MicroExpress, Chem USA, and AMS. The performance results were a scattered mix, to say the least. Some of these 200- and 233-MHz systems even scored lower than many of the 166-MHz systems tested. As a result, we did not pick a winner for this category.

The Sceptre Soundx 5500's performance score led the way; note, though, that it beat the top-performing 166-MHz by a mere 3 percent. However, new drivers will surely improve these higher-speed PCs in the months to come.



Not all batteries are born to run. Many of the laptops in our tests averaged around 3 hours of juice, but there were exceptions. Tillamook processors, though expected to score well on battery life, actually scored significantly lower. However, this is likely due to power-eating features like 4-MB graphics cards, 24x CD-ROM drives, and other hungry components.

TECH FOCUS

Intel's Tillamook and Beyond

We've seen a glimpse of Tillamook's performance leap (or lack thereof, in some cases). Many of the systems we tested, though, were preproduction units, so subsequent driver improvements should make a world of difference. However, sources at several notebook companies said that battery life should be extended by as much as an hour through Tillamook's low power consumption. Why? Tillamook is the first chip Intel is manufacturing on a smaller 0.25-micron process, which keeps power consumption and heat to a minimum. While Tillamook brings up notebook speed a notch, users likely won't see increases in performance thresholds until the second half of 1998, when Intel ships the mobile version of the Pentium II (code-named Deschutes).

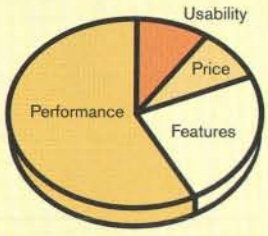
LAB RATING RESULTS

BEST OVERALL

Micron TransPort XKE

Micron's TransPort XKE bested all rivals in the 166-MHz crop. Though it's pricey (the third most expensive, behind the Gateway 9100 and the HP OmniBook), its extremely strong features and usability deliver the goods. Its 13.3-inch XGA screen supports 1024 by 768 resolution. On the high end of the battery life spectrum (4:72), it will accommodate a typical cross-country plane ride.

WEIGHTING



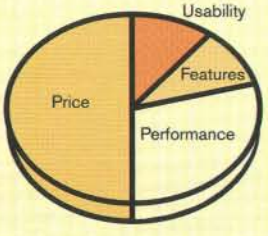
	PRICE	TECHNOLOGY	PRICE	PERFORMANCE	FEATURES	USABILITY	OVERALL RATING
Micron TransPort XKE	**$5399**	★★★★	★★	★★★★★	★★★★★	★★★★★	★★★★★
Gateway 2000 Solo 2300SE	$2599	★★★★	★★★★★	★★★★	★★★★★	★★★★	★★★★★
Gateway 2000 Solo 9100XL	$5699	★★★★	★★	★★★★	★★★★★	★★★★★	★★★★
Compaq Armada 7730 MT	$4399	★★★★	★★	★★★★★	★★★★	★★★★	★★★★
Acer/TI TravelMate 7060	$3999	★★★★	★★	★★	★★★★	★★★★	★★★★
Sony PCG-707C	$4499	★★★★	★★	★★	★★★★	★★★★	★★★★
Empac Classic 5166	$3500	★★★★	★★	★★★★	★★★	★★★★	★★★★
Hitachi VisionBook Pro	$4499	★★★★	★★	★★★	★★★★	★★★★	★★★★
Tatung TNB-5600	$3195	★★★★	★★★	★★★★	★★★★	★★★	★★★★
NEC Versa 6060	$3199	★★★★	★★★	★★	★★★★	★★★	★★★★
Toshiba Satellite Pro 460CDT	$3899	★★★★	★★★	★★	★★★	★★★	★★★
WinBook FX P166 MMX	$2999	★★★★	★★★	★★	★★★	★★★	★★★
CTX EzBook EZ 764MT	$3233	★★★★	★★★	★★★	★★	★★★	★★★
Dell Latitude XPI CD M166	$4348	★★★★	★★	★★	★★★★	★★★	★★★
Hewlett-Packard OmniBook 5700 CTx	$5400	★★★★	★★	★★★★	★★	★★★	★★★

BEST VALUE

Gateway 2000 Solo 2300SE

Hands-down, the Gateway Solo 2300SE is our low-cost winner. It scored exceptionally well in our performance tests, and its good usability and nice price make it the top choice for price/performance value. Additionally, its battery life spans 3:21 hours.

WEIGHTING



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Gateway 2000 Solo 2300SE	**$2599**	★★★★	★★★★★	★★★★	★★★★★	★★★★	★★★★★
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Gateway 2000 Solo 9100XL	$5699	★★★★	★★	★★★★	★★★★★	★★★★★	★★★★
Tatung TNB-5600	$3195	★★★★	★★★	★★★★	★★★★	★★★	★★★★
Compaq Armada 7730 MT	$4399	★★★★	★★	★★★★★	★★★★	★★★★	★★★★
NEC Versa 6060	$3199	★★★★	★★★	★★	★★★★	★★★	★★★★
Hitachi VisionBook Pro	$4499	★★★★	★★	★★★	★★★★	★★★★	★★★
Sceptre Soundx 4500	$2695	★★★★	★★★★	★★★	★★	★★	★★★
Empac Classic 5166	$3500	★★★★	★★	★★★★	★★★	★★★★	★★★
Acer/TI TravelMate 7060	$3999	★★★★	★★	★★	★★★★	★★★★	★★★
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Toshiba Satellite Pro 460CDT	$3899	★★★★	★★★	★★	★★★	★★★	★★★
WinBook FX P166 MMX	$ 2999	★★★★	★★★	★★	★★★	★★★	★★★
CTX EzBook EZ 764MT	$3233	★★★★	★★★	★★★	★★	★★★	★★★
Digital HiNote vp 575	$3999	★★★★	★★★	★★★	★★★	★★	★★★

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

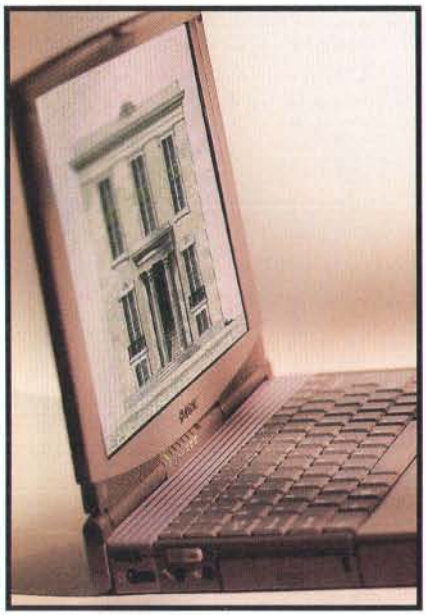
Results chart shows just the 15 highest-rated machines.

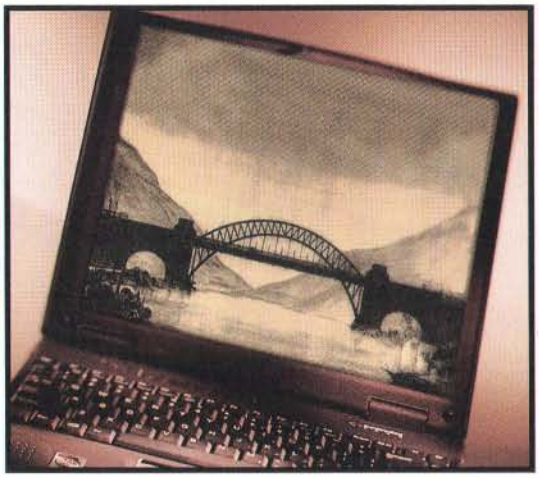
PHOTOGRAPHS: MICHAEL MAYO © 1997

DETAILS

Size Matters

Sony steers clear of shoulder-straining hell with its first laptop on the market, the thin and light PCG-705C. Skinny but not weak, it weighs 5.3 pounds and measures 1.5 inches thick. It sports a 166-MHz MMX processor, a 2.1-GB hard drive, and a removable 14x CD-ROM drive that can be replaced with a floppy disk drive or a second battery.





Graphics Diva

Less eyestrain is a good thing. Gateway kept this in mind when designing the Solo 9100XL, which has 4 MB of video memory and a 13.3-inch screen, capable of 1024 by 768 resolution. Like a few others we tested, it uses a high-performing 128-bit graphics accelerator.

Nice Touches

Compaq's Armada MT is the Martha Stewart of laptop computers. None of the fine details have been overlooked in its design, including programmable function keys and an indicator light right on the battery.

Tests Yield Few Surprises

Battery Life Blues

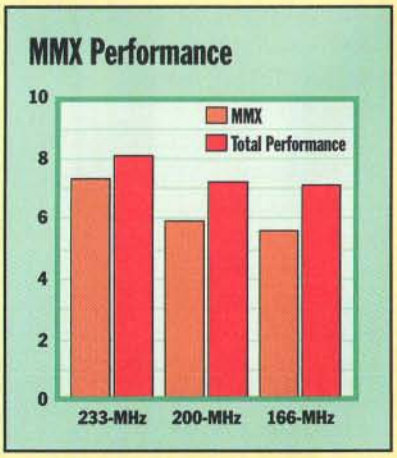
Battery life and power consumption are a hot issue concerning today's laptops. Though the 166-MHz systems led the way in terms of battery life, the 200- and 233-MHz laptops fell short of expectations. Keep in mind that factors such as screen lighting, hard disk, and memory strongly affect battery life. For example, something as simple as taking out half of your RAM can add 20 percent or more battery life. Sacrificing powerful components for longer battery life, however, may not be an option for those who need a laptop that can double as a desktop.

The Performance Predicament

Performance among the 166-, 200-, and 233-MHz machines varied widely in our tests. However, some general trends did surface from the benchmark results:

- Stable drivers play an important factor in a system's overall performance.
- Systems with faster processors tend to be faster, but in some cases, the difference is a very small margin.
- Systems with write-back cache tend to be faster.
- Systems with 512-KB cache tend to be faster.
- Unsurprisingly, 233-MHz machines are typically faster than 200-MHz machines.

"Tend to be" means "in general"; there are lots of counterexamples. Some systems are better designed than others. If we factor out the lower-performing Eurocom 7200 and Micro International 7200/mint from our tests, the 200-MHz and 233-MHz machines score fairly well.



Average MMX scores (scaled 1 -10) compared by CPU speed.

We picked the best portables based on their usability, features, performance, technology, and price, all on a scale of five stars. We rated the MMX notebooks by testing performance with a suite of application-based benchmarks (including Word, Excel and Access) and Intermark video-component benchmarks. We tested these elements separately and then formulated an overall score by assigning a weight to each element. The Overall category score is weighted 60 percent for performance, 20 percent for features, 10 percent for usability, and 10 percent for price.

We derived the performance rating by averaging the results from our performance tests. First, we measured the system's performance during a series of MMX tests. The second test consisted of a software-based battery test, a Windows application that records the power status of a system once every minute.

Features

To determine features scores, we measured each unit's capabilities in a few key areas. Each vendor completes a lengthy questionnaire providing a detailed description of its system's features and support options. NSTL then weighs certain features and calculates an overall score. The features chart lists the speed of the processor and availability of secondary cache, the display technology used, and maximum internal resolution. Other features items we weigh for the overall score include I/O ports, graphics and sound systems, fax/modem communications, and power supplies.

Warranty and support policies are what frequently separate major system manufacturers from second- and third-tier vendors. The length of the standard warranty is one of a system's most important features. We also look for the availability of on-site service, on-line support, and a toll-free help line.

Usability

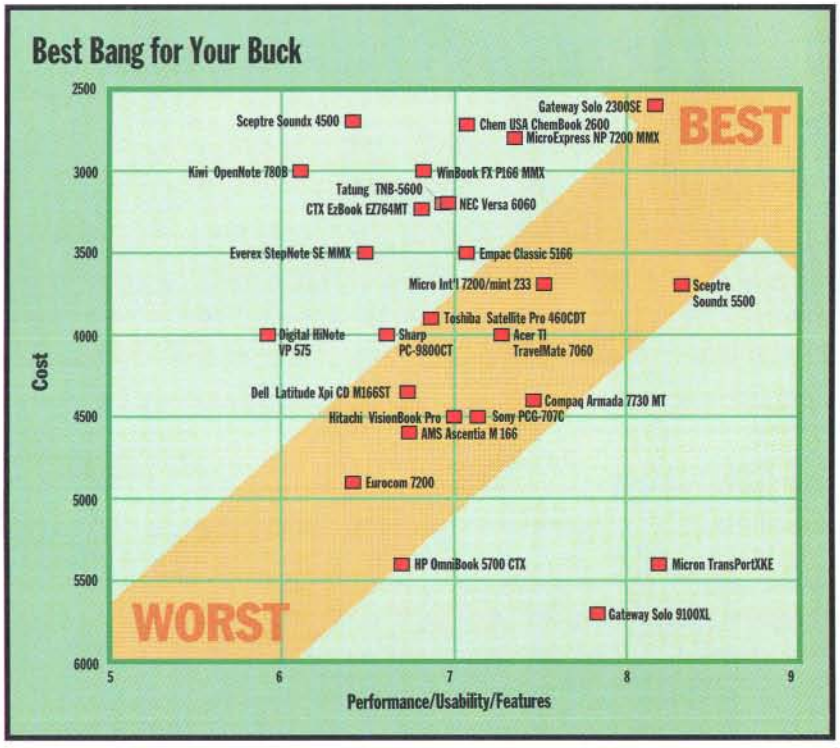
For usability, we focus on two key areas: system design and documentation. We paid close attention to the quality of each keyboard, concentrating on keyboard placement. If a system offers a comfortable typing position, we award it extra points. Additionally, we rate the ease of use and placement of pointing devices. Top honors were given to systems with recognizable status indicators for low battery and hard disk access. We rate the manuals for their organization, diagrams, and index. Finally, we determine how easy it is to install batteries and upgrade system RAM.

Performance

For our performance tests, we use NSTL's applications-based suite, which consists of Microsoft Word, Excel, and Access. These tests portray real-world situations by running macros that execute common functions. For example, the Excel test measures the time it takes to delete a variety of cell ranges and calculate various addition, financial, and statistical functions. The Word benchmark includes subtests that measure search-and-replace functions, changing fonts, scrolling by page and line, checking spelling, print-previewing, and printing to a file. In addition, NSTL's Intermark subsystem-level Windows tests exercise the video/graphics subsystems.

Since these systems use MMX processors, our tests measure multimedia performance. An MMX test, provided by Intel, puts the systems through a gauntlet of multimedia tasks. The automated test suite includes some photo editing with Adobe Photo Deluxe, an Intel multimedia video clip, an MPEG-1 video file, a Direct 3D game, and business photo manipulation with Adobe Photoshop. These are all common tasks that MMX technology is designed to enhance.

Our battery check consists of power consumption and battery-drain tests that are executed by Power Monitor, a simple Windows application that records the power status of a fully charged battery. Status is recorded until the system suspends itself due to low battery power.



Evaluations in this report represent the judgment of BYTE editors, based on tests conducted by NSTL, Inc., as documented in a recent issue of NSTL's monthly PC Digest. *To purchase a copy of the full report, contact NSTL at 625 Ridge Pike, Conshohocken, PA 19428; 610-941-9600; fax 610-941-9950; on the Internet, editors@nstl.com. For a subscription, call 800-257-9402. BYTE Magazine and NSTL are both operating units of The McGraw-Hill Companies, Inc.*

POWER PORTABLES FEATURES

		Price as Tested (MSRP)	Overall Rating	CPU Speed (MHz)	Hard Disk Capacity Formatted (in GB)	STANDARD FEATURES 16-Bit Sound	Fax/ Modem	CD-ROM Drive	Keyboard/ Mouse Port	Video Memory (MB)
Acer America	Texas Instruments TravelMate 7060	$3999	★★★★	166	2	✔	✔	Option bay	✔	1.2
AMS Tech	TravelPro 2030CX	$4595	★★★★	200	3.1	✔	✔	Swap	✔	2
Chem USA	ChemBook 2600	$2729	★★★★	200	2.1	✔	✔	Option bay	✔	2
Compaq Computer	Armada 7730MT	$4399	★★★★	166	2.1	✔	✔	Swap	✔	2
CTX International	EzBook EZ764MT	$3233	★★★	166	2	✔	Optional	Option bay	✔	1.5
Dell Computer	Latitude XPi CD M166ST	$4348	★★★	166	2.1	✔	Optional	✔	✔	1.1
Digital Equipment	Digital HiNote VP 575	$3999	★★	166	2.1	✔	Optional	Option bay	✔	1.125
Empac International	Empac Premium M2X	$3500	★★★★	166	2	✔	✔	✔	✔	2
Eurocom	Eurocom 7200	$4899	★★★	233	3	✔	Optional	✔	✔	4
Everex Systems	StepNote SE	$3499	★★★	166	2.1	✔	✔	Swap	✔	1.5
BYTE Best: Gateway 2000	Solo 2300SE	$2599	★★★★★	166	1.3	✔	✔	✔	✔	1.15
Gateway 2000	Solo 9100 XL	$5699	★★★★	166	3	✔	✔	✔	✔	4
Hitachi PC	VisionBook Pro	$4499	★★★★	166	2.1	✔	✔	Option bay	✔	2
Hewlett-Packard	HP OmniBook 5700CTX	$5400	★★★	166	2.7.	✔		Swap	✔	2
Kiwi Computers	Kiwi OpenNote 780B	$2999	★★	166	2	✔	✔	Swap	✔	1
MicroExpress	MicroExpress NP7200MMX	$2799	★★★★	200	1.4	✔	✔	✔	✔	2
Micro International	7200/mint	$3690	★★★★	233	3	✔	Optional	✔	✔	4
BYTE Best: Micron	TransPort XKE	$5399	★★★★★	166	3	✔	✔	✔	✔	2
NEC Computer Systems Division	Versa 6060	$3199	★★★★	166	2.1	✔	✔	Option bay	✔	2
Sceptre Technologies	Soundx 5500	$3695	★★★★	233	3	✔	N/A	Swap	✔	1.5
Sceptre Technologies	Soundx 4500	$2695	★★	166	2	✔	✔	✔	✔	1.5
Sharp Electronics	PC-9800CT	$3999	★★★	166	2.1	✔	✔	Option bay	✔	2
Sony Electronics	Sony PCG-707C	$4499	★★★★	166	2.1	✔	✔	Swap	✔	2
Tatung Company of America	TNB-5600	$3195	★★★★	166	1.4	✔	✔	Swap	✔	2
Toshiba America Information Systems	Satellite Pro 460CDT	$3899	★★★	166	2	✔	✔	Swap	✔	2
WinBook	WinBook FX P166MMX	$2999	★★★	166	2.16	✔	✔	Option bay	✔	2

BYTE Best = BYTE Best ✔ = yes; N/A = not applicable.

Warranty: P = parts; L = labor; F = freight to repair center; R = return to customer.

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

		DISPLAY		CUSTOMER SERVICE				
Internal AC Adapter/ Battery Charger	Type of Pointing Device	Display Manufacturer/ Size (in inches)	Maximum Internal Resolution	Warranty	Toll-Free Phone Number	Phone	On-Line Address	Inquiry Number
✔	Glide pad	Hitachi/12.1	800×600	3/P, L, F, R	800-733-2237	408-432-6200	http://www.acer.com	1075
	Glide pad	Panasonic/13.3	1024×768	3/P, L	800-886-2671	626-814-8851	http://www.amstech.com	1076
✔	Glide pad	Sharp/12.1	800×600	1/P, R-3/L, R	800-866-2436	510-608-8818	http://www.chemusa.com	1077
✔	Pointer stick	Compaq/12.1	800×600	3/P, L, F, R	800-345-1518	281-370-0670	http://www.compaq.com	1078
	Glide pad	Neomagic/12.1	800×600	1/P, L, R	800-888-9052	909-595-6146	http://www.ctxintl.com	1079
	Trackball	Samsung/12.1	800×600	1/P, L-3/P	800-388-8542	512-338-4400	http://www.dell.com	1080
	Trackball	LG/12.1	800×600	1/P, L	800-344-4825	508-493-5111	http://www.windows.digital.com	1081
	Glide pad	Goldstar/12.1	1024×768	1/P, L	800-938-8878	510-683-8800	http://www.empac.com	1082
	Glide pad	Samsung/13.3	1024×768	1/P, L, R	None	613-224-6122	http://www.eurocom.ca	1083
	Glide pad	LG/12.1	800×600	2/P, L, R	800-821-0806	510-498-1111	http://www.everex.com	1084
✔	Glide pad	Sanyo or Sharp/12.1	800×600	1/P, L	800-846-2000	605-232-2000	http://www.gateway2000.com	1085
✔	Glide pad	NEC 13.3	1024×768	1/P, L	800-846-2000	605-232-2000	http://www.gateway2000.com	1086
✔	Glide pad	Hitachi/12.1	800×600	3/P, L, F, R	800-555-6820	408-321-5000	http://www.hitachipc.com	1087
	Pointer stick	Samsung or Hitachi/12.1	1024×768	3/P, L, R	800-322-1501	415-857-1501	http://www.hp.com	1088
	Glide pad	Goldstar or NEC/11.3	800×600	3/P, L, F, R	None	408-492-9188	http://www.kiwicom.com	1089
✔	Glide pad	Hitachi/12.1	800×600	4/P, L, R	800-989-9900	714-852-1400	http://www.microexpress.net	1090
✔	Glide pad	Samsung/13.3	1024×768	1/P, L, R	800-967-5667	281-495-9096	http://www.pcmint.com	1091
✔	Pointer stick & glide pad	Micron or Toshiba/13.3	1024×768	3/P, L, F, R	888-634-8799	208-893-3343	http://www.micronpc.com	1092
	Glide pad	NEC/12.1	800×600	3/P, L, F, R	888-863-2669	508-264-8000	http://www.nec-computers.com	1093
✔	Glide pad	IBM/13.3	1024×768	1/P, L, R	800-788-2878	626-369-3698	http://www.sceptretech.com	1094
	Glide pad	Mitsubishi/12.1	1024×768	1/P, L, R	800-788-2878	626-369-3698	http://www.sceptretech.com	1095
✔	Glide pad	Sharp/12.1	1024×768	3/P, L, F, R	800-237-4277	201-529-8200	http://www.sharp-usa.com	1096
✔	Glide pad	Sony/12.1	1024×768	1/P, L, F, R	800-476-6972	941-768-7676	http://www.sony.com/pc	1097
✔	Glide pad	Hitachi/12.1	800×600	2/P, L	800-827-2850	310-637-2105	http://www.tatungusa.com	1098
✔	Trackball	Proprietary/12.1	800×600	3/P, L	800-334-3445	011-352-460-433	http://computers.toshiba.com	1099
	Pointer stick	Samsung/12.1	800×600	1/P, L, F, R	800-965-5147	N/A	http://www.winbook.com	1100

These virtual private network packages let you use the Internet as your own private WAN.
By Morgan Stern

Extend Your Net with VPNs

Have you ever tried to have a private conversation in a public place? It's not easy. Have you ever listened in, inadvertently or intentionally, to someone else's private conversation? If so, you'll understand the increasing popularity of virtual private networks (VPNs).

The Internet offers a great way to communicate, but it's not very good for transmitting secrets. You never know who's listening, and a well-placed packet sniffer can compromise your confidential communications.

VPNs eliminate the hazards of conducting private conversations in public networks by making your communications intelligible only to the person with whom you want to communicate. VPNs encrypt IP datagrams, use strong authentication before allowing communication, and check data integrity to assure packets arrive at their destination unchanged.

Organizations implementing VPNs leverage their relatively inexpensive Internet connections to build virtual WANs with secured access for off-site employees, remote offices and business partners. VPNs reduce the costs of building and maintaining internal dial-up infrastructures or more expensive point-to-point WAN links.

The VPN Puzzle

VPN-enabled devices typically fit in at the network perimeter. These devices might link the network to individuals in a client-to-LAN configuration, effectively extending the internal network out to the remote user, or they might connect to another VPN-enabled device, thereby creating a virtual, encrypted point-to-point link between two separate networks.

LAN-to-LAN VPNs hide functions like data encryption from end users. The devices on the LAN at the remote end of the VPN link appear to be part of the corporate network: The VPN operates entirely transparently to the user. Client-to-client VPNs, on the other hand, employ software (on a workstation) that intercepts all network traffic destined for a VPN-linked host and adds the necessary encryption elements. End users communicate securely with hosts running compatible VPN software without affecting access to non-VPN hosts.

BYTE BEST
VIRTUAL PRIVATE NETWORK

Aventail VPN 2.5
Aventail offers the best combination of encryption, authentication methods, and end-user ease of use. Its ability to provide additional content filters on a service-by-service basis is a particularly useful feature that most of the other products currently lack.

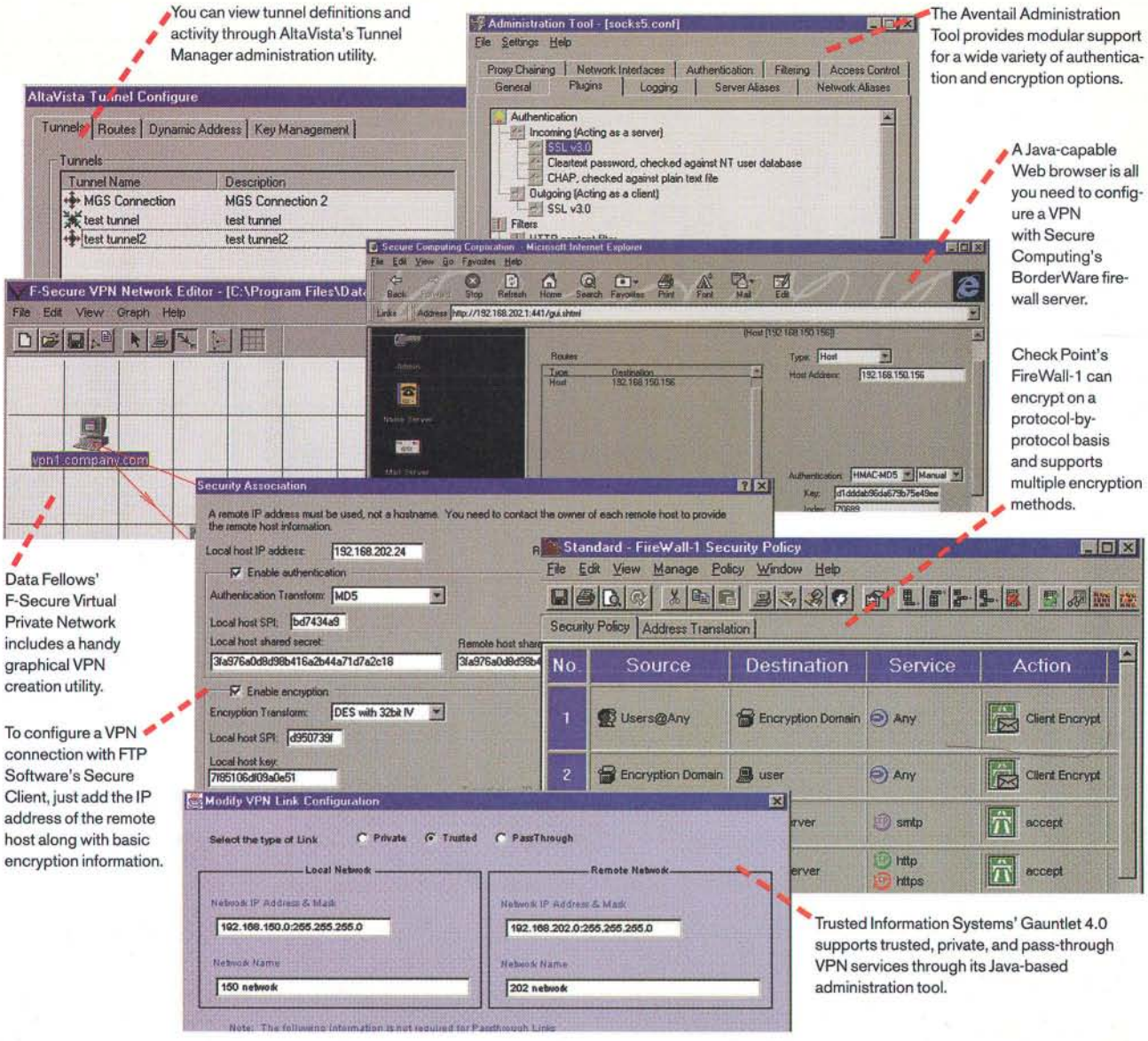
A VPN requires three functions: encryption, authentication, and data integrity. Typically each VPN node uses a secret session key and an agreed upon encryption algorithm to encode and decode session data, exchanging session keys at the start of each link using public key encryption. VPN nodes also must confirm that the entity at the other end of the connection is who they say they are. Most VPNs use public key authentication methods to validate each end of the connection; some may additionally require the end user to supply an account name and password. Finally, both endpoints of a VPN link check data integrity, usually using a cryptographic hash or digest function such as Message Digest 5 (MD5) or Secure Hash Algorithm 1 (SHA-1). MD5 is a public-domain standard for generating 128-bit cryptographic checksums. SHA-1 is a hashing function for generating 160-bit cryptographic checksums. Developed as part of the Digital Signature Standard (DSS) by the U.S. Department of Commerce and the National Institute of Standards and Technology, SHA-1 performs an advanced form of a checksum on all data received.

Testing Testing 1, 2, 3

For this report, we selected 10 VPN products. They reflect three different approaches to VPN implementation. In addition to four stand-alone VPN products, we tested four firewall servers with VPN features and two packages that integrate VPN functions into network and operating system-level products.

Most of the products combine a variety of encryption methods, algorithms, and key lengths, so developing a consistent testing methodology that could produce meaningful results was impossible. I tested for overall security, ease of use, manageability, and interoperability, with particular attention to individual security elements, such as supported encryption schemes, key length, authentication methods, and data integrity support.

Aventail VPN currently offers the best combination of supported standards, management features, and ease of use. Impressively versatile, it makes creative use of the SOCKS protocol (frequently



While their operation is mostly transparent, VPNs all need configuration and administration interfaces.

used by proxy firewalls) as its primary VPN mechanism. Two other products rank highly: Check Point's FireWall-1 and Raptor Systems' Eagle NT. Both add an extra level of security by integrating VPN features with firewall functionality, so you can provide varying levels of controlled access to VPN users once they've been authenticated.

Vendors define the term "VPN" very broadly; each product reviewed here offers some kind of VPN functionality, but each implementation is also unique. Almost every product solves at least one problem better than the others. For example, Data Fellows' F-Secure Virtual Private Network 1.1 works for multinational organizations looking for the highest encryption options available to connect multiple networks, while products like FTP Software's Secure Client and Sun Microsystems' SunScreen SKIP shine at client-to-client communications. Firewall-based products, like FireWall-1, Eagle NT, and BorderWare, help corporations that must combine VPN versatility with the security of a firewall.

The VPN product category is still in its early stages. Only five of the products would interoperate for me: the firewalls, FireWall-1, BorderWare, and Eagle NT, and two clients, FTP Secure Client and SunScreen SKIP. Properly configuring them to work together is not for the faint of heart. As protocols such as the IPSec family become officially standardized, and as VPN vendors implement them, expect true interoperability to become a core feature of all VPN software. For now, plan to stick with a single vendor to ensure VPN compatibility—organizations planning to establish VPNs with business partners must choose carefully.

AltaVista Tunnel 97

AltaVista Tunnel 97, a dedicated VPN, supports tunneled LAN-to-LAN (available through the Workgroup edition) or client-to-LAN (with the Personal Edition) connections. Managing keys with the included Tunnel Manager application is more

VPN ARCHITECTURE FEATURES

	AltaVista Tunnel 97	Aventail VPN 2.5 (B)	Check Point FireWall-1 3.0a	Data Fellows F-Secure Virtual Private Network 1.1	FTP Software Secure Client 3.0	Microsoft Routing and Remote Access Service	Raptor Eagle NT 4.0
VPN FEATURES							
Supports LAN-to-LAN	✔	✔	✔	✔		✔	✔
Supports client-to-LAN	✔	✔	✔			✔	✔
Supports client-to-client					✔		
Supports PPTP						✔	
Supports compression				✔		✔	
IP payloads	✔	✔	✔	✔	✔	✔	✔
IPX/NetBEUI payloads						✔	
Supports IPv6 carrier		✔			✔		
Supports IPSec (rfc 1825)		✔	✔		✔		✔
Supports SKIP key management			✔				
Other key management	✔	✔	✔	✔	✔		✔
Supports multiple tunnels from single server	✔	✔	✔	✔		✔	✔
Supports multiple tunnels from single client		✔	✔		✔		✔
ENCRYPTION FEATURES							
RSA	✔	✔	✔	✔		✔	
DES		✔	✔	✔	✔		✔
Triple-DES		✔	✔	✔			✔
IDEA				✔			
Blowfish				✔			
RC2							✔
RC4	✔	✔	✔			✔	
Diffie-Hellman		✔	✔				
MD4		✔				✔	
MD5	✔	✔	✔	✔	✔		✔
SHA-1		✔	✔	✔			✔
Full strength available for unlimited export				✔			
Supports automatic key exchange during session	✔	✔	✔	✔		✔	
Does it support encryption on a service-by-service basis?		✔	✔				
MANAGEMENT AND ADMINISTRATION							
Manage access levels by group		✔	✔			✔	
SNMP-manageable			✔			✔	✔
Remote manage via HTTP							
Remote manage via Java							
Remote manage via other			✔			✔	✔
Directory support for LDAP							
Directory support for NDS		Bindery only					
Other directory support		A	B			A	B
Includes client software			✔		✔	✔	
Client/server support:							
Windows 3.x		C					C
Windows 95	C	C	C		C	C	C
Windows NT	C/S	C/S	C/S			C/S	C/S
Solaris		C/S	S				S
BSD		C/S		S			
Other Unix	S	C/S	S				S
AUTHENTICATION FEATURES							
CHAP/PAP		✔				✔	
RSA	✔			✔			
RADIUS		✔	✔			✔	✔
S/Key			✔				✔
SecurID		✔	✔				✔
Other token authentication			✔				✔
SSL		✔					
Does it support filters?		✔	✔			✔	✔
Is user authenticated by IP address?			✔		✔		✔

B = BYTE Best ✔ = Yes A = NT Domain directory support B = directory file import support C = client support S = server support

Secure Computing BorderWare Firewall Server 4.1	Sun Microsystems SunScreen SKIP 1.1	TIS Gauntlet 4.0
✔	✔	✔
✔	✔	✔
	✔	
✔	✔	✔
✔	✔	✔
	✔	
✔		✔
✔	✔	✔
	✔	
	✔	✔
✔	✔	✔
✔	✔	✔
	✔	
✔	✔	
✔	✔	
✔	✔	✔
	✔	
✔	✔	✔
	✔	
	✔	
		✔
✔		
✔		✔
✔	✔	
	✔	
	C	
	C	S
S		S
		S
✔		
		✔
✔		✔
✔		✔
✔		
✔		✔
✔	✔	✔

intuitive than with many of the other products reviewed, and the ability to control how much of the internal network to make available to VPN users is a very useful feature. A setup wizard and well-organized administrator's guide simplify installation, but compared to the other products reviewed, Tunnel's narrower encryption support and less flexible implementation reduce its appeal. Tunnel 97 is a good product hobbled by relatively limited capabilities and feature set.

Aventail VPN 2.5

Aventail has taken a different approach to creating a VPN product, and the results seem unusual at first. Aventail impressed me with its flexibility, extensive support for encryption methods, and array of authentication options. Unlike other VPN products that tunnel encrypted packets, Aventail implemented a reverse SOCKS proxy gateway to provide VPN capabilities and encryption functions at the session layer. Encryption and authentication can be controlled on a service-by-service level, and additional filters can be employed to limit user access or protect them from potentially hostile Java code or ActiveX components.

Authentication and encryption methods are implemented as software modules, so adding new standards as they evolve should be as easy as installing a new module. Administrators can exercise as much (or as little) control as they want over their VPN users. With its multiple authentication and subauthentication options, and multiple platform support for both servers and clients, Aventail is extremely versatile.

Check Point FireWall-1 3.0a

Check Point extends FireWall-1, one of the most popular firewall servers on the market, to include support for both LAN-to-LAN and client-to-LAN VPNs. Similar to Eagle NT, FireWall-1 lets administrators create VPN connections with unrestricted network protocol access, or they can create VPNs with an extra level of security by enabling the firewall to restrict or permit certain types of traffic. Adding traffic restrictions on VPN links, limiting the type of application that can be run, makes sense when connecting to business partners.

Configuring a FireWall-1 VPN is complicated, but it is also much more flexible than most and supports a wider variety of encryption and authentication options. For organizations that already use FireWall-1 as their firewall server, adding VPN functionality is a no-brainer.

Data Fellows F-Secure Virtual Private Network 1.1

Developed in Finland, F-Secure VPN boasts freedom from any export restrictions, which means that international organizations are free to implement a full-strength version at all their locations. Its graphical VPN configuration design utility let me create our VPN definition with drag-and-drop simplicity. However, F-Secure supports only LAN-to-LAN VPNs, and each endpoint network requires a dedicated VPN server, based on a stripped-down NetBSD kernel with limited hardware support. Undocumented configuration parameters that were needed to get the software to work with our 3Com network cards hampered installation.

FTP Software Secure Client 3.0

FTP's Secure Client offers VPN functionality as a component of a full-featured Windows 95 TCP/IP client implementation, unlike the other VPNs. Secure Client replaces Microsoft's IP stack and supports both IPSec and SOCKS security. Its ability to interoperate with other VPN products is impressive, as is its client-to-client communication encryption function. However, with security features limited to client communications, Secure Client scores poorly compared to products offering both client and LAN VPN capabilities. As a standalone product, Secure Client might not meet all your VPN needs, but it could fit in nicely if used with other products.

Trusted Information Systems Gauntlet 4.0

Gauntlet 4.0, from Trusted Information Systems, also incorporates VPN functions into an existing firewall framework, supporting three types of VPN configurations: private, trusted, and pass-through. Private links provide secure communications, with the added safeguard of forcing all communications to be evaluated by the firewall rules. Trusted links provide full, unlimited access between VPN sites. Pass-through mode lets you implement a third-party VPN product in addition to Gauntlet. You configure Gauntlet at the server console or through a Java-based management applet.

Gauntlet 4.0's extensive support for different authentication modes provides a

LAB RATING RESULTS

BEST OVERALL

Aventail VPN 2.5

Aventail's extensive VPN features give it an edge over some close competition.

	TECHNOLOGY	VPN FEATURES AND FUNCTIONS	IMPLEMENTATION	EASE OF USE	OVERALL RATING
Aventail VPN 2.5	★★★★	★★★★	★★★★	★★★★	★★★★
Check Point FireWall-1 3.0a	★★★★	★★★★	★★★★	★★★	★★★★
Microsoft Routing and Remote Access Service	★★★	★★	★★★	★★★	★★★
Raptor Systems Eagle NT 4.0	★★★★	★★★★	★★★★	★★★	★★★
Secure Computing BorderWare Firewall Server 4.1	★★★★	★★★	★★★	★★	★★★
Sun Microsystems SunScreen SKIP 1.1	★★★	★★★	★★★	★★	★★★
Trusted Information Systems Gauntlet 4.0	★★★	★★★	★★★	★★★	★★★
AltaVista Tunnel 97	★★	★★	★★★★	★★★	★★
Data Fellows F-Secure Virtual Private Network 1.1	★★★	★★	★★	★★	★★
FTP Software Secure Client 3.0	★★★	★★	★★	★★	★★

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

secondary level of security. In a private VPN scenario, users can first authenticate to the VPN server, then use an authentication token such as SecurID to access individual servers or services. VPN support is currently available only in the Unix version of Gauntlet; the NT version is slated to have VPN support soon.

Microsoft Routing and Remote Access Service

Routing and Remote Access Service (see "Software-Only Routing for NT," September BYTE) offers VPN functionality through Microsoft's Point-to-Point Tunneling Protocol (PPTP). RRAS can do 128-bit encryption. It can authenticate only through NT's directory service or through Remote Authentication Dial-In User Service (RADIUS). Overall security would benefit from the addition of some form of certificate authentication on the client end. However, RRAS's availability as a free download makes it an attractive option for budget-conscious organizations with modest security requirements. In addition, RRAS offers enhanced multiprotocol routing and dial-up support for remote users, and it's easy to set up.

Raptor Eagle NT 4.0

Raptor's Eagle NT firewall/VPN combo scored well thanks to its support for multiple encryption and authentication schemes, as well as its ability to selectively control access to internal resources through the firewall access rules. I was also

TECH FOCUS: SECURITY

Grab Your SOCKS

Most software VPN products use one of two methods for providing data security. Either they encrypt entire IP packets and "tunnel" them within plain packets, or they encrypt only the data portion of the packet and include clues for how to decrypt the data. Aventail VPN, however, takes a totally different approach: using SOCKS to provide both encryption and access control.

SOCKS, a security technology, uses circuit-level proxies to relay information between networks. All traffic destined for a remote network must be transmitted to a SOCKS server via the SOCKS protocol. The server then establishes a proxy connection to the requested resource and returns the data to the original requester. No traffic ever passes directly between the two networks.

One of the traditional disadvantages of SOCKS has been that every client that wanted to access the SOCKS server had to use specially modified applications (the term for modifying an application is known as "socksifying"). Companies like Aventail avoid the socksification requirement by creating a specialized Winsock as part of their AutoSOCKS client. The AutoSOCKS Winsock.dll works with any Winsock-compliant application, so software such as Web browsers or FTP clients can work without modification.

The latest version of SOCKS, version 5, includes a number of enhancements over previous renditions, such as support for multiple authentication, encryption, and message integrity functions, as well as support for UDP packets.

The Harder Side of VPNs

All the VPN products reviewed here are software-based, but hardware-based VPN solutions are also increasingly popular. Many router companies, such as Cisco and Bay Networks, are offering VPN functionality within their routers and dial-up access products. Cisco introduced Layer 2 Forwarding (L2F), a tunneling protocol similar to Microsoft's Point-to-Point Tunneling Protocol (PPTP), while Bay offers its BayStream IP Virtual Circuit technology.

With either of these product lines, users connect to the dial-up or LAN-based router using standard utilities, such as Windows 95 dial-up networking. All encryption functions are handled by the router, which establishes the virtual connection with the router at the destination network. Once end users have been authenticated, they may be totally unaware that they are connecting to their resources through an encrypted channel.

VPN functions, particularly encryption, tend to be computation-intensive, so another class of hardware-based VPN devices has emerged that offers faster overall encryption performance. Products such as the VSU-1000, from VPNet Technologies, connect directly to the network to provide authentication, encryption, and compression services for both client-to-LAN and LAN-to-LAN VPN sessions.

Because the encryption code is contained within hardware, these devices have the ability to manage more sessions at higher bandwidth levels than their software counterparts. Radguard's clPro (slated to be available in October) is a second-generation VPN product that supports IPSEC standards for Layer 3 encryption. Radguard claims clPro can encrypt IP packets at bandwidth speed for as many as 1000 concurrent users.

impressed with its monitoring and logging capabilities, though Eagle NT suffered from some minor glitches during testing. For example, it allowed only dial-up VPN sessions from a LAN workstation running Windows 95 version OSR2; other versions of Windows worked fine.

BorderWare Firewall Server 4.1

Configuring the BorderWare Firewall server for VPN sessions is extremely easy thanks to its Java-based remote administration utility and simplified setup menu. Configuring the server hardware itself, however, is not so easy. Like F-Secure, BorderWare is based on a stripped-down Unix kernel, so hardware support is more limited than for the other products. Once we got all the right pieces together, installing the software was not a problem. BorderWare's combination of firewall and VPN functionality is a plus because it gives you the ability to define varying levels of access for VPN clients.

SunScreen SKIP

Like FTP's Secure Client, SunScreen SKIP is a client-based package. It works on Windows95 or Solaris 2.5.x computers and installs as a virtual network interface, so it can be managed through the Control Panel in the Win 95 version. SunScreen SKIP supports the SKIP key management scheme, so you'll be able to establish secure connections without the hassle associated with manually exchanging encryption keys. One of the more attractive features of SKIP—not found in some of the tunnel-based products—lets you define secure and nonsecure hosts, and all traffic between your workstation and those hosts will be encrypted accordingly. Overall, SunScreen is easy to work with; however, it does lack the full feature set of server-based products.

Digging Your Own Holes

Choosing the right VPN product for your organization requires careful thought about your requirements. Client-to-client encryption products, like those from FTP Software and Sun, might be best for decentralized organizations or those with many mobile users. International corporations might prefer Data Fellows' F-Secure VPN because of its full-strength cryptography and no export controls.

The products that scored best in our testing—Aventail VPN, Check Point FireWall-1, and Eagle Raptor NT—did well because each offers a good combination of encryption and authentication options, along with support for both LAN-to-LAN and client-to-LAN VPN connections. They proved to be the most versatile and easy to use of all the products in this roundup.

However, VPN software is a rapidly progressing product category, and many of the technical obstacles I encountered, such as lack of product interoperability, will fade as open standards for security evolve. Look for big changes in the next revisions of all of these products. B

Morgan Stern **(morganst@world.std.com)** *is a network consultant and coauthor of* NT Enterprise Network Design *(Sybex, 1997).*

PRODUCT INFORMATION

AltaVista Tunnel 97
Workgroup version from $995; Personal version from $99
AltaVista Internet Software, Digital Equipment Corp.
Littleton, MA
508-486-2308
fax: 508-486-2017
http://www.altavista.software.digital.com
Enter 1052 on Inquiry Card.

Aventail VPN 2.5
Server, $4995; client, $65
Aventail
Seattle, WA
206-777-5600
fax: 206-777-5656
http://www.aventail.com
Enter 1053 on Inquiry Card.

BorderWare Firewall Server 4.1
$4000-$13,000
Secure Computing
Roseville, MN
612-628-2700
fax: 612-628-2701
http://www.securecomputing.com
Enter 1059 on Inquiry Card.

Check Point FireWall-1 3.0a
$4995, 50 users; $18,995, unlimited users
Check Point Software Technologies
Redwood City, CA
650-482-4900
fax: 650-562-0410
http://www.checkpoint.com
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Eagle 4.0
from $6500
Raptor Systems
Waltham, MA
800-9-EAGLE-6
781-487-7700
fax: 781-487-6755
http://www.raptor.com
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F-Secure Virtual Private Network 1.1
$4995 (includes 2 servers)
Data Fellows
San Jose, CA
408-938-6700
fax: 408-938-6701
http://www.datafellows.com
Enter 1055 on Inquiry Card.

Gauntlet 4.0
from $5000
Trusted Information Systems
Rockville, MD
301-527-9500
fax: 301-527-0482
http://www.tis.com
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Routing and Remote Access Service
free download
Microsoft
Redmond, WA
206-882-8080
fax: 206-936-7329
http://www.microsoft.com
Enter 1057 on Inquiry Card.

Secure Client 3.0
$300 (single unit)
FTP Software
Andover, MA
800-282-4387
508-685-3300
fax: 508-794-4488
http://www.ftp.com
Enter 1056 on Inquiry Card.

SunScreen SKIP 1.1
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Sun Microsystems
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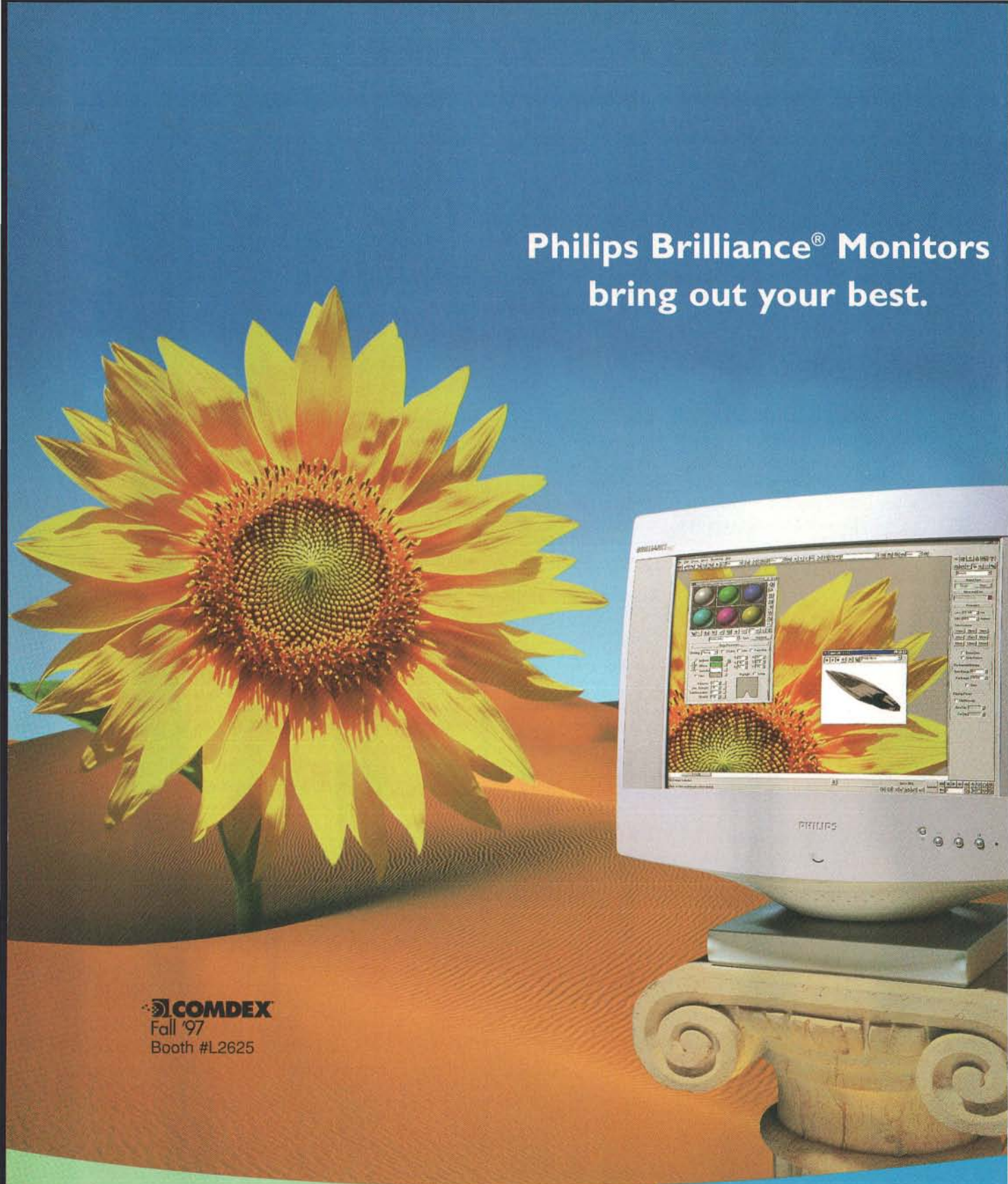

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PHILIPS

Let's make things better.

Circle 151 on Inquiry Card (RESELLERS: 152).

End-user cryptography tools mature as standards evolve and interfaces improve. ***By Pete Loshin***

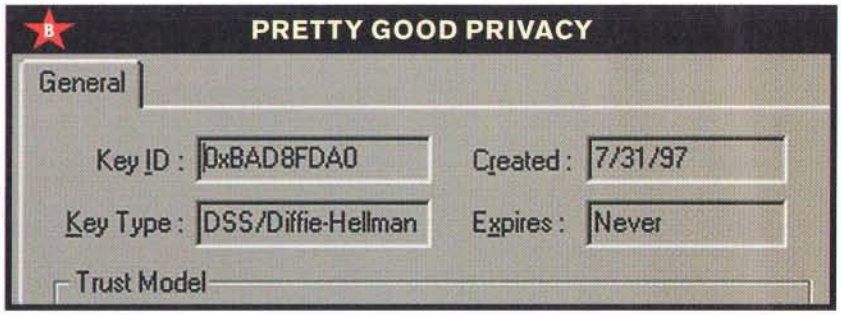
Cryptography Gets Personal

With Internet security issues in the headlines, software vendors are answering the call with a variety of personal encryption products. Some, like Symantec's Norton Your Eyes Only (YEO) for Windows 95 and RSA's SecurPC 2.0, secure files and directories with proprietary architectures on your desktop. Others, such as the offerings from Netscape and Microsoft, bundle S/MIME secure e-mail functions into Internet clients for e-mail encryption and digital signatures. In between, Entrust/Solo from Entrust Technologies offers a minimalist point of entry for individuals into Entrust's open security architecture, while Pretty Good Privacy's PGP for Personal Privacy 5.0 combines e-mail and desktop security with a "web of trust" certificate model (see "Who Goes There?," June BYTE).

In my tests of ease of use, functionality, and interoperability, PGP led the pack with its comprehensive personal security solution. No one package aced the interoperability test: While PGP hews to its own de facto standard, the S/MIME clients fared unevenly when dealing with standard key and certificate formats. Entrust/Solo accepted only Entrust certificates. YEO does public-key encryption, but with a proprietary architecture, so only YEO keys will work. SecurPC does only symmetric encryption and cannot yet handle X.509 certificates. SecurPC, YEO, and Entrust/Solo do secure e-mail only as attached encrypted files, while Netscape's Communicator Suite and Microsoft's Internet Explorer (IE) 4.0/Outlook combination can exchange encrypted or signed e-mail—but it can't encrypt files.

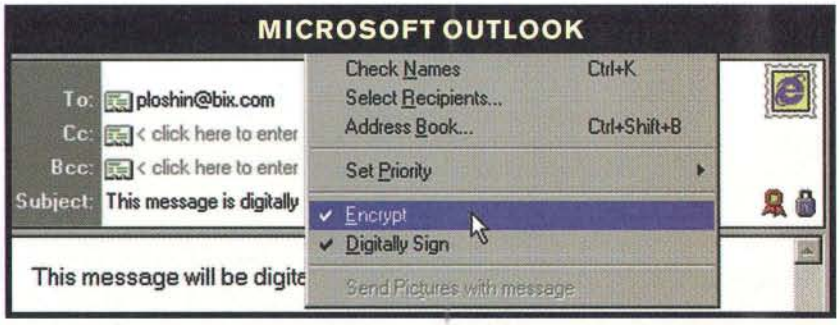
Entrust/Solo

A spin-off of Nortel, Entrust has a Canadian location that permits it to export cryptography with minimal limits. Entrust sells enterprise security tools for building certification authorities (CAs) and clients for using the certificates.

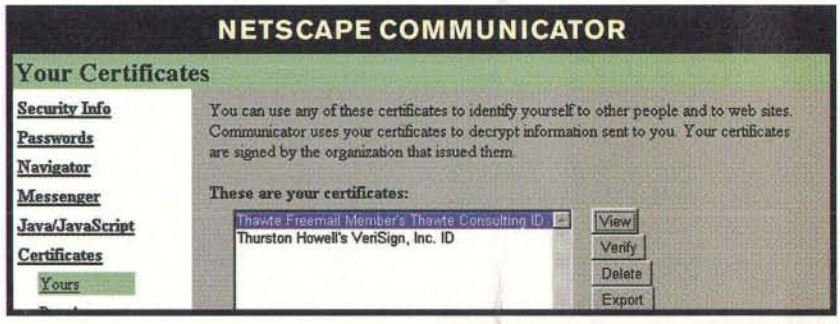


RATINGS	
TECHNOLOGY	★ ★ ★ ★
IMPLEMENTATION	★ ★ ★ ★

Solo encrypts or decrypts and signs or verifies signed files using Entrust-format public keys and file formats only. You can compress encrypted files and drag directory hierarchies into encrypted archive files, do a secure delete, or administer your own or others' Entrust-formatted keys. Solo uses the RSA public-key-encryption algorithm, although other (higher-priced)



RATINGS	
TECHNOLOGY	★ ★ ★
IMPLEMENTATION	★ ★



RATINGS	
TECHNOLOGY	★ ★ ★
IMPLEMENTATION	★ ★ ★

Entrust clients can add Directory Server Agent (DSA) support. Support for stream ciphers, used to encrypt the actual files, includes DES, Triple-DES, and three strengths (64-, 80-, and 128-bit keys) of CAST, a patented encryption algorithm that's owned by Entrust (but with a free version available for both commercial and noncommercial use).

Solo offers an easy entry point for secure communications with Entrust organizations. Solo runs on Windows 95 only; other Entrust clients work on the Mac, Unix, and Windows 3.x.

Microsoft Outlook/IE 4.0

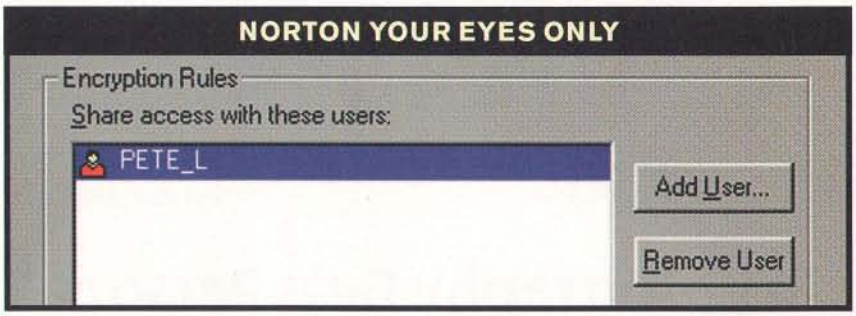
Microsoft's IE 4.0 (see "Microsoft's Free-Lunch Browser," June BYTE), Outlook, and Outlook Express are all more-than-adequate clients for most uses. To catch up with Netscape's S/MIME-based secure e-mail function, Microsoft added S/MIME support for digital signatures and public-key encryption of e-mail sent and received among Outlook clients.

Unlike stand-alone solutions, the Microsoft and Netscape products both need a CA, such as Verisign or Thawte, to issue you an X.509 certificate that lives in the client software. Once you get the certificate, you must load it into your Outlook e-mail account properties before you can do any cryptography. Microsoft's S/MIME implementation may not win prizes or solve all security needs, but it makes the IE 4.0/Outlook combination competitive with Netscape's Communicator.

Netscape Communicator

Netscape created Internet client cryptography, building Secure Sockets Layer (SSL) into Navigator 1.0. This year, S/MIME e-mail made its way into Navigator and Messenger in the Communicator suite.

Communicator makes it look easy: You just click on the Security menu-bar option for easy access to all security (including S/MIME) functions. You manage certificates and toggle the defaults for encryption and digital signatures on your e-mail and news postings, although you can modify the default for some messages by clicking on the Message Sending Options in Communicator's Composition application. Netscape did a better job of implementing S/MIME than Microsoft did, while supporting the same features. As tested, neither solves all your crypto needs, but both can do what they claim: S/MIME e-mail encryption and digital signatures.



Norton Your Eyes Only

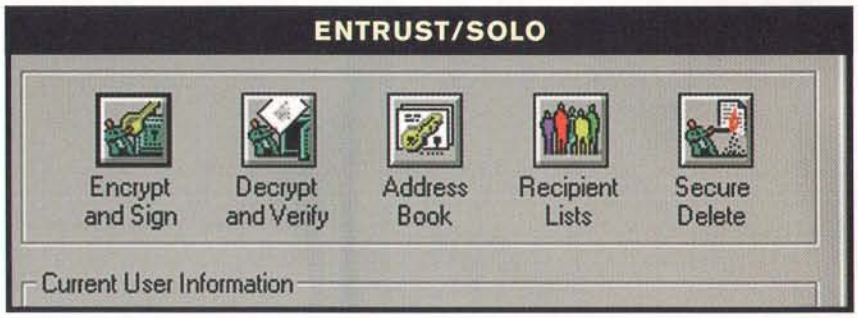
RATINGS	
TECHNOLOGY	★ ★ ★
IMPLEMENTATION	★ ★ ★

Symantec's Norton YEO for Windows 95 encrypts data so transparently that at first I thought it wasn't working. When you log on to YEO, you get access to all files encrypted in place, as well as to any files stored in auto-encrypt directories, but access is seamless throughout. I had to copy an encrypted file to disk and open it on another PC to be sure it was encrypted.

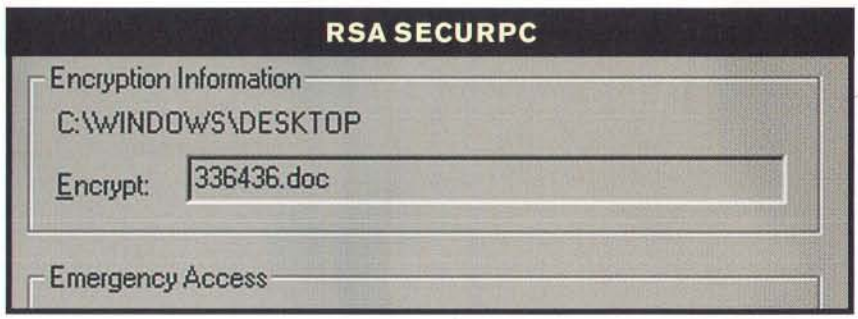
If you don't log onto YEO on boot-up, you can access unencrypted data on the system, but you must reboot to get to encrypted data. YEO does clever things with its desktop integration, including figuring out which file a shortcut icon points to and encrypting it instead of the shortcut.

Like Entrust/Solo, YEO can encrypt and digitally sign e-mail—but only as a file attachment. YEO will not interoperate with any other encryption program and can't import standard certificates or keys (although a companion product, Norton Your Eyes Only Administrator, offers central key distribution and master access to YEO-protected desktops or data).

YEO uses the RSA public-key algorithm and offers a choice of data-encryption algorithms, including RC4, RC5, and DES. YEO can protect your desktop data, but lack of interoperability keeps it out of the running as an all-around crypto tool.



RATINGS	
TECHNOLOGY	★ ★ ★
IMPLEMENTATION	★ ★ ★



RATINGS	
TECHNOLOGY	★ ★ ★
IMPLEMENTATION	★ ★ ★ ★

PGP for Personal Privacy 5.0

I enjoyed using PGP with the same sense of unease with which I enjoy sushi: There's

We have won the industry's technology awards, now let's have fun making money!

Suggestions for ScanOffix:

The comprehensive solution for office and home, ScanOffix is the ideal complement to your scanner and offers intuitively user-friendly capabilities for processing images and text. Now you can simplify routine jobs, organize data, use the Internet to the fullest, expedite procedures, streamline your workspace, and much more. ScanOffix takes advantage of the latest image manipulation technology to let you explore your creativity and perfect aesthetics in any presentation with capabilities for "Photocopying" in color, morphing, seamlessly fusing images, and creating virtual photo albums. Take charge of your computer with the newest generation of intuitive imaging technology - ScanOffix.

Suggestions for FunScan:

FunScan consists of six user friendly imaging applications in one awesome value-added package. With FunScan you can make your own greeting cards, and T-Shirts, play puzzle games and design your own screensaver and Internet homepages. Using our state-of-the-art technology, your scanner is now intuitive and easy.

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Circle 155 on Inquiry Card (RESELLERS: 156).

Crypto-Tool Features

	Entrust/ Solo	RSA SecurPC	Norton Your Eyes Only	Pretty Good Privacy B	Microsoft Internet clients	Netscape Communicator
Public-key encryption for e-mail	A		A	✔	✔	✔
E-mail digital signatures	✔			✔	✔	✔
X.509 certificates	*				✔	✔
Secure files	✔	✔	✔	✔		
Secure directories	✔	✔	✔			
Boot protection		✔	✔			
Screenlock		✔	✔			
Secure delete		✔	✔			
Public-key encryption for desktop	✔		✔	✔		
File digital signatures	✔			✔		
S/MIME support	*				✔	✔
Platform support	Win 95/NT	Win16/32, Mac OS	Win 95	Windows, MacOS	Win 95/NT	Win16/32, Mac OS, Unix
Telephone	613-247-3400	650-595-8782	541-334-6054	650-572-0430	206-882-8080	650-254-1900
On-line address	http://www .entrust.com	http://www.rsa.com	http://www .symantec.com	http://www.pgp .com	http://www .microsoft.com	http://home .netscape.com
Inquiry number	**1110**	**1108**	**1109**	**1107**	**1111**	**1112**

B = BYTE Best. A = by attaching encrypted files to e-mail. ✔ = yes. * = interoperable only with other Entrust clients and through Entrust server products.

always a nagging sense that it's bad for me in the long run. With plug-ins for Qualcomm's Eudora and Microsoft's Outlook e-mail clients (and Netscape Messenger and Lotus cc:Mail plug-ins are coming soon), PGP is a click away at all times. With a key-management tool, you can go look for someone's PGP key or just grab it out of e-mail with the plug-in. PGP's desktop integration enables you to encrypt and/or sign any file or decrypt and/or verify any PGP-encrypted file; the clipboard integration does the same for cut chunks of files.

So what makes me uneasy? It's the standards. Even though PGP has millions of users, because S/MIME is bundled increasingly visibly in Microsoft Internet clients and in Netscape's WebPass ID (rolled out with CA Verisign), PGP's installed base looks mighty small. However, with standards decisions still up in the air, PGP's comprehensive and easy-to-use implementation puts it head and shoulders over the other products, and its availability outside the U.S. makes it an ideal choice for those who prefer stronger international protection but don't feel comfortable going for one of Entrust's heavier clients.

RSA SecurPC 2.0

The oddest thing about SecurPC, from RSA, is its relative lack of public-key cryptography. Other than public-key encryption of user keys, SecurPC does nothing but symmetric encryption: no signing of files, and no encrypting a file with someone else's public key. SecurPC recently won approval for export of its full-strength encryption, making it attractive for international use. Otherwise, it functions like YEO, with encrypt files and directories, boot protection, screen lockout, and secure deletes.

SecurPC is activated only when you right-click on a file. One big feature is a self-extracting encrypted file, which can be decrypted by anyone with the secret key you select, making it possible to at least e-mail encrypted attachments to recipients who don't have SecurPC. Like YEO, SecurPC should suffice for simple desktop protection, but its lack of support for digital signatures and interoperability limits its usefulness as a stand-alone solution. B

Pete Loshin is a BYTE technical editor for software reviews and author of the forthcoming book Personal Encryption Clearly Explained *(AP Professional, 1998). You can reach him at* **ploshin@mcgraw-hill.com.**

TECH FOCUS: STANDARDS

Cryptographic Standards Meet the Internet—Head-On

When is a standard not a standard? Perhaps when it's a proposed Internet standard that uses proprietary technology. When (at the end of August) RSA's S/MIME (Secure/MIME) proposal got what seemed to be a brush-off from key players at the IETF, PGP rushed to take advantage and propose a new specification for secure e-mail based in part on the Pretty Good Privacy "web of trust" model, where certificates gain authority by being signed by people you know. Called OpenPGP, the standard would also permit a hierarchical approach to accommodate certification authorities (CAs), X.509 certificates, and other already-accepted standards.

S/MIME's backers, accused of foot-dragging, saw their baby apparently consigned to the bit bucket by an onslaught of negative press—until IETF officials relented on the terms they would require from RSA before considering S/MIME. RSA is meeting these terms, including making freely available its proprietary algorithms for use in S/MIME implementations. S/MIME's reliance on U.S.-exportable (i.e., 40-bit) keys for encryption still troubles opponents. The weak keys represent a compromise to turn S/MIME into a global solution, but this approach could backfire, since U.S. and foreign users alike might ultimately reject such breakable encryption. This is particularly true if a stronger solution is available—something like PGP, as PGP officials are happy to point out. However, with Microsoft, Netscape, and many other vendors standing behind their support for S/MIME, by next year it may very well replace PGP as the de facto standard for secure e-mail, no matter what the IETF does.

Although there's plenty of cheaper competition, these two Web servers are more capable and dependable than ever. ***By Barry Nance***

Battle of the Network Superservers

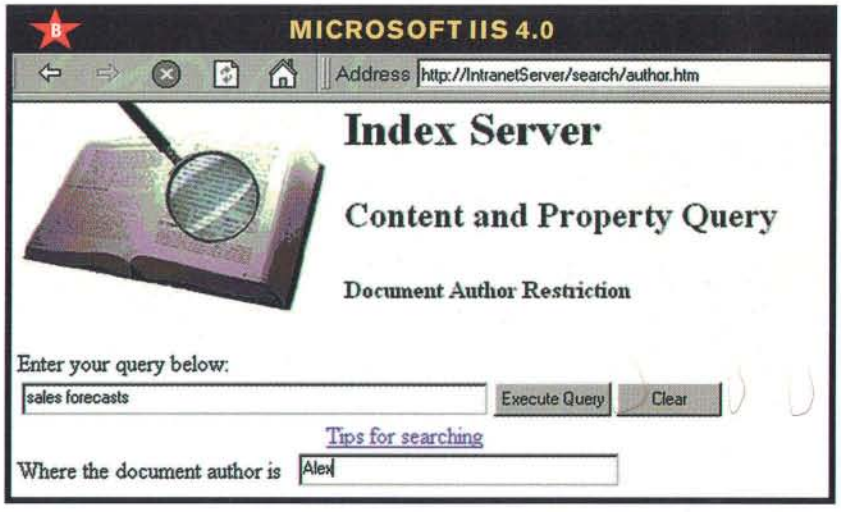
Netscape and Microsoft are lusting for your Web-server business in a dense marketplace crammed with over 200 other competitors. Moreover, the current market leader, Apache, doesn't cost a dime. Should you plunk down cold hard cash for Netscape's SuiteSpot or Microsoft's Internet Information Server (IIS)? If so, which one?

A year ago, comparing Netscape's and Microsoft's Web server suites was easy—Netscape's product was feature-rich, ran on multiple platforms, and was almost as fast as IIS 3.0. But IIS 4.0, which was in final beta form during this review, has pulled even with SuiteSpot 3.0 in many areas—and surpassed it in others.

I evaluated IIS 4.0 and SuiteSpot 3.0 on an intranet consisting of Pentium Pro–based NT Server 4.0 machines, an Ethernet LAN running TCP/IP, and a variety of clients (Windows NT, Windows 95, OS/2 Warp, and Macintosh System 7). I compared features, performance, ease of administration, reliability, and suitability for running (or developing) transaction-oriented business applications.

SuiteSpot proved to have a better messaging server, streaming audio server, and groupware server. However, IIS showed a slightly better search engine, a better transaction-oriented business application environment, and more-effective administrative tools. A forthcoming Microsoft proxy server also proved to be superior to Netscape's.

IIS is a part of Windows NT Server, while SuiteSpot is a separate product. Each contains a different mix of software components. To compare similar functions across both, I arbitrarily added Microsoft's NetShow (freeware) and Proxy Server (beta version) to the evaluation. As this article went to press, Microsoft wasn't sure whether it would bundle Proxy Server with NT Server.



Microsoft IIS 4.0

ADVANTAGES

+ Good proxy and transaction servers; well suited for business applications
+ Capable, quick, versatile search engine

DISADVANTAGES

– Runs only on Windows NT Server
– Awkward audio and video integration

RATINGS	
TECHNOLOGY	★ ★ ★ ★
IMPLEMENTATION	★ ★ ★

Microsoft's IIS 4.0 is a significant upgrade over its predecessor. Version 4.0 makes Active Server Page (ASP)–based applications even easier to create and manage. IIS's debugger for testing ASP pages, the Microsoft Management Console (MMC) interface, and Transaction Server all simplify the management of ASP-based applications. Web pages produced from ASP scripts can now be part of a transactional system, which helps ensure data integrity.

IIS is the first product to use MMC, which will be standard in Windows NT 5.0. MMC gave me greater control over Web server settings than Netscape's tools did, and I liked being able to set properties such as access controls with a simple mouse-click. The basic IIS logging function now supports the W3C Extended Logging standard, so administrators can capture just the data they want.

Management of secure transactions remains a highlight of IIS, allowing businesses to easily secure Web pages and directories. You see files, directories, and applications in an Explorer-like interface and can view properties simply by right-clicking. Configuring rights and security settings was child's play. In addition, when I ran several Web sites on one server, I could specify how much server bandwidth to give to each site.

One item often overlooked in evaluating IIS is that, in contrast to Netscape's Internet-oriented servers, NT Server can be both a file server and a Web server at the same time. Referring to a remote drive letter and printing to a shared printer haven't yet gone out of style.

IIS 4.0, which complies with HTTP 1.1, has a certificate server for creating and

managing digital certificates. It also comes with a search engine, a news server, Microsoft Transaction Server, and SiteServer Express (stripped-down log- and site-analysis tools for Web-site managers).

The new certificate server made it easy to create and distribute small numbers of digital certificates. It's appropriate for small companies or departments but needs more sophisticated management tools to maintain large numbers of certificates.

Microsoft's new Web server has a number of new features that should make it a more stable application server. I could run programs as processes in address spaces separate from those of the Web server. This means a badly behaved application is less likely to crash the Web server.

Proxy Server 2.0, despite its bias toward Windows clients, bested Netscape's. The new fault-tolerance and reverse-proxy features impressed me. I was able to chain multiple Proxy Servers together for redundancy and load balancing, a feature Netscape's Proxy Server 2.5 also supports.

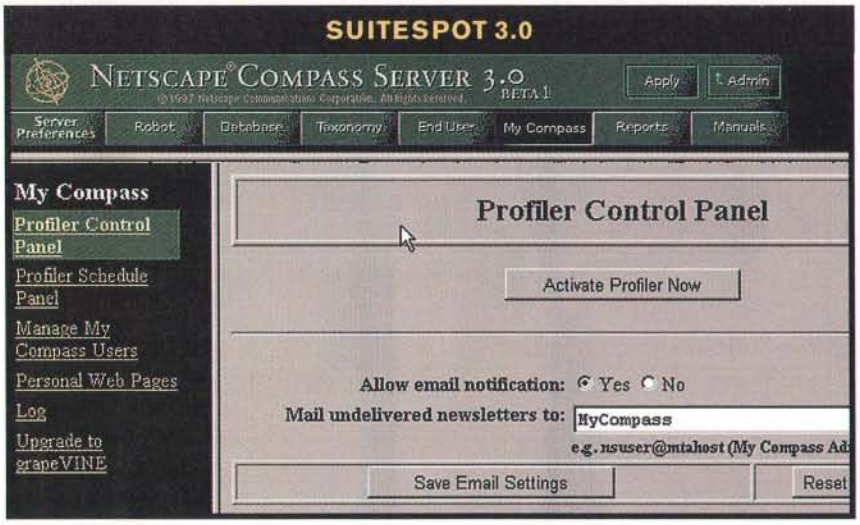
However, Microsoft surpassed Netscape's distributed caching by introducing the concept of arrays, which enables multiple Proxy Servers with the same name to run as mirrors of one another. I configured Proxy Server both to republish Web pages from protected Web servers and to publish multiple Web sites on a single server using multihoming support for multiple URLs and IP addresses.

I liked the way Microsoft has integrated Proxy Server with Remote Access Service (RAS) to allow access to the Internet for dial-up connections. An entire network can share a single ISP dial-up connection. Wizards helped me configure Proxy Server as a router that would dial the ISP each time a client accessed a remote site.

The Index Server component of IIS tested slightly better than Netscape's Compass Server. While neither is as well endowed as, say, Infoseek's Ultraseek Server search engine, both provided basic, useful search tools for locating information on the test intranet.

I especially liked IIS's ability to handle different document types, its programmability, and its ease of administration. Index Server successfully indexed Office 97 (Excel and Word for Windows) files and Adobe PDF documents in real time. It allowed full-text and HTML field searching by word or phrase and integrated closely with NT Server. But Index Server has no natural-language interface and doesn't support proximity searching. It does, however, support seven national languages.

Microsoft's NetShow (which is freely downloadable) integrates closely with IIS to serve up streaming audio, video, and Web-enhanced presentations. While NetShow's authoring tool gave me a time line that helped me insert audio, graphics, and URLs accurately, I couldn't insert video clips directly. In fact, NetShow is rather rudimentary, with no tools for capturing audio or video. To convert audio or video files into Microsoft's .asf format, you must first use a separate tool to make your source material conform to the frame and bit rate you select. I preferred Netscape's Media Server to NetShow.



RATINGS	
TECHNOLOGY	★ ★ ★
IMPLEMENTATION	★ ★ ★

SuiteSpot 3.0

ADVANTAGES

+ Good messaging server
+ Server-based agents

DISADVANTAGES

– Inconsistent administrative tools
– Awkward directory-server interface

The standard Edition of SuiteSpot 3.0 includes Enterprise Server 3.0, Calendar Server 1.0, Messaging Server 3.0, Collabra Server 3.0, and Directory Server 1.0. The Professional Edition adds Proxy Server 2.5, Media Server 1.0, Certificate Server 1.0, and Compass Server 3.0. Both versions of SuiteSpot also include LiveWire Pro 1.0, Informix OnLine Workgroup Server, and NetObjects Fusion.

SuiteSpot remains a work in progress; only the Enterprise, Collabra, Compass, and Messaging servers (which make up the critical core) represent updated software. It also lacks a single administrative interface. From Communicator 4.0, I could use Netscape's new administrative tool to manage only the updated servers. The tool centralizes common tasks, such as maintaining user accounts, via the Directory Server component. When I added a user or group, the change propagated automatically to the other version 3.0 servers. However, I had to use the version 2.0 administrative tool to update the down-level servers, making changes one server at a time.

The Collabra and Messaging servers carry new version numbers but haven't changed greatly. Only Enterprise Server and Compass Server offer significant improvements, such as Web Publisher, a Java applet for remotely managing content on a Web server. The new Enterprise Server also offers server-based agents. I configured the agents to monitor intranet pages and perform daily searches. Because the agents are server based, I could access them from multiple systems.

Compass Server (formerly Catalog Server) is a customized version of the Verity search engine. I liked Compass Server's support for more than just HTML and plain text, its personalization options, and its easy administration. However, as with IIS, Compass Server lacked proximity searching and a natural-language interface.

In my tests, Compass Server accurately indexed Microsoft Office (Excel and Word), PDF, and WordPerfect files. Net-

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verity CONNECTING PEOPLE WITH INFORMATION
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THE DOCUMENT COMPANY XEROX

scape claims that Compass Server can also catalog Rich Text Format (RTF), PowerPoint, Interleaf, Lotus Word Pro, and FrameMaker files.

Compass Server allowed me to specify words and phrases with Boolean operators, and it performed phonetic lookups and synonym matching. I could locate documents based on metadata entries I had placed inside the HTML, and Compass Server let me categorize my documents into topics (*taxonomies* in Netscape parlance). The categorization made search responses immensely more relevant.

Compass Server let me painlessly create what Netscape calls a *personal interest profile subscription*. Thereafter, each time I updated Web pages or documents, Compass Server's indexer automatically used my URL classification rules and taxonomy designations to prepare and send me, via e-mail, a My Compass newsletter, containing the updated Web content I'd expressed an interest in.

The Messaging Server adds tools such as receipt acknowledgement and encrypted messaging via Secure Multipurpose Internet Mail Extensions (S/MIME). I would have liked Messaging Server more if it incorporated some Exchange and Notes features, such as server-based rules for filtering messages.

SuiteSpot's mail server has an Internet e-mail underpinning, supporting SMTP, Post Office Protocol Version 3 (POP3), and MIME. Exchange and Notes have only recently embraced these standards.

Calendar Server, which Netscape has licensed from Corporate Software and Technologies International, adds long-awaited group scheduling to SuiteSpot, along with yet a third administrative interface. Calendar Server lets you schedule people and resources so that you can manage time, events, and to-do lists. Collabra is a groupware product that supports ad hoc discussions, searching across forums, and virtual forms. Netscape plans to integrate Collabra to run as an LDAP process. Currently it, too, requires separate administration.

Netscape Directory Server is an LDAP-compliant server supplying a universal directory service for enterprise-wide management of user, access-control, and server configuration. (LDAP is a subset of X.500, a directory-services standard.) Netscape has a lot of work to do to improve Directory Server and integrate it with the other SuiteSpot components. When I set up a group list, I had to enter the cryptic LDAP query syntax. Netscape needs to provide a better interface.

While Netscape wants developers to use JavaScript, Microsoft touts VBScript and JScript, its own take on JavaScript. Microsoft's Java version, J++, also contains proprietary extensions (if you discount the fact that Microsoft has handed ActiveX over to a standards body). From a developer's point of view, using Microsoft tools for cross-platform applications is like walking a very thin tightrope. Active Server Pages is a more compelling technology than Netscape's servlets, making platform selection for developers even more difficult.

Perhaps the answer to this dilemma lies in Netscape's announced Open Network Environment (ONE), a cross-platform architecture that employs an object model (Netscape Internet Foundation Classes) and offers support for distributed objects through the CORBA-compliant IIOP protocol. Although ONE competes directly with Microsoft's OLE/ActiveX/DCOM architecture, Netscape says that ONE will include ActiveX technology and will be compatible with Oracle's NC Architecture.

Media Server consists of server software, a set of conversion and audio-editing tools, and client-side software. It also includes the Netscape Media Converter, the ToolVox voice encoder and client, Navigator, and the Media Player client. Media Server did an excellent job, compressing and distributing audio almost as well as RealAudio. Like RealVideo, MediaServer can deliver different files for users with different bandwidths. I also found that MediaServer can serve on-demand or live audio feeds, either multicast or unicast.

While IIS is only for use with NT machines, SuiteSpot comes in versions for NT, Sun Solaris, IBM AIX, HP-UX, SGI's Irix, and Digital's Unix.

In short, SuiteSpot provides remote Web content management with version control, and its centralized directory holds great promise. However, Netscape needs to better integrate the disparate server modules, especially the administrative tools.

M or N?

For many Webmasters, server software comes down to a choice between Microsoft and Netscape. The decision is an easy one to make if you already have NSAPI-aware (Netscape) or ISAPI-aware (Microsoft) applications. If you're developing a Web-based system, I believe that IIS's ASP technology is the way to go. And IIS is much easier to administer.

On the other hand, if all you're looking for is a server for distributing static Web pages, then either one, or almost any of the other 200 competing products, will do. B

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TECH FOCUS: SMART INDEXING

SQL Access to Web Sites

Unique among all search-engine products—not just the two Web servers reviewed here—Microsoft's Index Server 2.0 can accept queries expressed in SQL, in addition to traditional keyword and phrase arguments. To use this feature, you develop a query program in Visual Basic, J++, C++, or VBScript. This connects to the ActiveX Data Object (ADO), which passes the request to Index Server, which then returns a result set containing information from Index Server's internal catalog. Microsoft says that adding the SQL capability allows companies to treat highly structured Web sites like relational databases.

I wrote a small VBScript program that successfully connected to the Index Server catalog. However, my attempts to use a variety of relational-database query tools (e.g., Microsoft Access) failed. Nonetheless, the concept of accessing a search engine's catalog via SQL statements is a novel one that I hope Microsoft develops further in future versions of Index Server.

PRODUCT INFORMATION

Internet Information Server 4.0
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Microsoft Corp.
Redmond, WA
800-662-6796
206-882-8080
http://www.microsoft.com
Enter 1062 on Inquiry Card.

Netscape SuiteSpot 3.0
Standard Edition, $3495 for 50 users; Professional Edition, $4750 for 50 users
Netscape Communications Corp.
Mountain View, CA
800-638-7483
415-937-2555
http://home.netscape.com
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Jerry Pournelle

Chaos Manor

Fooling Around with the Web

Jerry finds some new tools to help him work on his Web site—and finds time for a visit to SIGGRAPH.

I have just spent the weekend chairing a meeting of the Citizens Advisory Council on National Space Policy. Fifty rocket scientists and the administrator of NASA made for some intense discussions. I'm a bit exhausted, and I've got the meeting reports to write. With luck, you'll find some of the results on my Web site, and there will be a link to the council's Web site as soon as we get that set up.

I've been fooling around with the Web again. You can see my latest efforts at http://home.earthlink.net/~jerryp, not the easiest thing in the world to remember, but it works. I've been quite happy with Earthlink's services, and it's a lot easier than trying to maintain my own servers for a Web site. It's also a lot cheaper, since my page comes free with the Earthlink basic services.

It's not a fancy site. I've been offered help by some of the best people in this business—for that matter, BYTE has some of them on its staff—but the point of this exercise is to see what I can do more or less unaided. I did have David Em help me get started, but it's pretty much mine now. It will always be a text-oriented site—I'm a wordsmith, not an artist—but I'm learning about whizbangs, and over time I may drop a few in.

On that score, have a look at the home page at http://www.lynda.com. New Riders author Lynda Weinman has some good demonstrations. Her husband has an absolutely mad page called "Stink," with more demonstrations of what you can do. It also has links to what he calls a "hall of shame": bad Web sites, at least two of which managed to crash Netscape as I tried frantically to get away from them.

Another interesting place is http://www.webmonkey.com, which has tutorials. I have only recently realized, although I may have known it for a while, that with Netscape, you can "view" the original HTML source code of a site that does things you find interesting and capture it to a file to have examples to work with.

In my case, I have the wonderful Olympus D-300L digital camera, which makes it a snap to get digital pictures. It will even take pictures of text pages, diagrams, and, for that matter, other pictures. Olympus has steadily improved the software that comes with the camera. It's now easy enough to use that I can recommend it to nearly anyone able to use a computer, especially if they have a BYTE reader helping the first time they download pictures and play with them.

It will always be a text-oriented site—I'm a wordsmith, not an artist.

The D-300L comes with Adobe PhotoDeluxe, a sort of poor man's Photoshop. PhotoDeluxe is all right, but if you really want to touch up photographs—both digital photos from a camera like the D-300L or scanned images of regular photos—look at Kai's Photo Soap from MetaCreations. I find that Paint Shop Pro from Jasc is about the best all-purpose photo-tinker program I have. Photoshop is said to be better—and perhaps it is—but I find Paint Shop Pro a great deal easier to understand, and it's what I've been using for most Web photo work.

Photo Soap is amazing: it can do automatically what the other programs can accomplish only if you know what you're doing. If you have old photographs or you're a lousy photographer, try Photo Soap. Then when you get the picture the way you want it, use Paint Shop Pro to put it into JPEG format with the "progressive" option. That saves the picture in interlaced layers, so that when it is first downloaded, it appears as a blurry outline with progressively sharper detail.

PhotoDeluxe saves JPEG files in linear fashion: you see the top stripe of the picture and then the next, etc. It's possible that PhotoDeluxe will save in interlaced or progressive mode, and Photoshop will, but after 10 minutes of tinkering with manuals and help files, I wasn't able to make it work. With Paint Shop Pro I got it first try, so that's the one I'll be using.

GRAPHICS FILES TAKE A LOT OF disk space. It's also hard to know what's in a file. The other day, I used the D-300L to shoot a series of pictures of the tenth Sunday after Trinity service at St. Mary's. I downloaded them from the camera to the Fujitsu magneto-optical (MO) disc. The download software lets me give a root filename—in this case, `trini` for Trinity—and will then give each a unique name, so I ended up with `trini0.jpg` to `trini26.jpg`. Not all of them were taken at St. Mary's—some were on the camera before I started—and some were a great deal better than others for putting up on the Web site.

If you build your Web pages with Microsoft Office 97 Word, it will give you a preview of a picture you're about to insert, but that's still a painful way to select pictures. Much better is ThumbsPlus, a shareware program that makes thumbnail sketches of your graphics files. You can aim ThumbsPlus at an entire disc,

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and it will find every graphics file and make a thumbnail.

We had one problem with ThumbsPlus. Graphics files tend to be big, and with the D-300L, I can make a lot of them. In 1024-by 768-pixel resolution, the D-300L holds 30 pictures; but in VGA (640 by 480 pixels), it will hold over a hundred, each one 50 KB and more in full-image JPEG (i.e., the images are compressed, but no detail is lost; as opposed to partial-quality JPEG, which blurs out some details as it compresses the file).

With Quick View Plus, you can look at nearly anything.

It seemed natural to combine the D-300L with the Olympus MO drive. The Olympus MO and Fujitsu MO drives use the same medium and format, so discs are interchangeable between them. MO discs hold 128 to 230 MB (there are larger ones, but I never find them at Fry's) and cost under $20; a lot of storage for the money. They're a natural accessory to a digital camera, so when I download my photographs from the D-300L, they go onto an MO disc.

Then I found that ThumbsPlus would look at the MO drive, pretend to make thumbnails—and do nothing. This was frustrating, and the help file had nothing, so I called the programmer. "Do you have a volume label on the MO disc?" he asked. "We use that in making the database."

A quick check showed I didn't, so I added one. After this, ThumbsPlus worked perfectly with the MO discs. This program has quickly become essential: if you do any graphics work, get ThumbsPlus and pay the registration fee. You'll be glad you did. Highly recommended.

Another utility worth having is Quick View Plus for Windows 95 (Win 95) and NT. This will plug into Norton Commander for Windows 95 and NT, and view nearly any file, including graphics files. It doesn't seem to view JPEG files saved by Paint Shop Pro in progressive format, although it has no problem with the same file saved linearly. Otherwise, I haven't found much that it won't show. Of course, Quick View Plus will work by itself or in conjunction with other file management software (including Explorer), but I particularly like it with Commander 95.

Commander has always been my favorite file manager, but the Windows version lacks the wonderful viewers that the last DOS versions had. With Quick View Plus, you can look at nearly anything, including individual components of ZIP files, DLLs, uuencoded files, and all kinds of stuff. I prefer to use it with Commander, because when I use Explorer and double-click on a file, I am never sure what will happen; with Commander, F3 brings in Quick View Plus and nothing else. Together, Commander and Quick View Plus are a killer combination. Recommended.

Finally, there's PhotoRecall from G&A Imaging. While this does limited special effects, mostly it's useful for organizing photographs into albums. It does that reasonably well, but it doesn't seem to have

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a batch capability. That is, to make a new album, I have to select and load pictures one at a time. Once that's done, it's easy to move them around in the album.

The presentation is quite good: a small, medium, or large picture in an album layout. Click on it to get the full-size picture. There's also a way to search the Web for pictures, although most pictures I have found on the Web are not ones I would want to download and keep. As a presentation system, PhotoRecall is neat, but as a management system for lots of photographs, I greatly prefer ThumbsPlus.

IN THE COURSE OF PLAYING WITH the Web, we upgraded our software, and that generates this month's tales of hope, horror, and glory.

Begin with CyberMedia's Oil Change. If you regularly cruise the Internet, you need this program, which finds and downloads updates to your software. In our case, it found an update to Dial-Up network and one to Win 95 Winsock. We downloaded and installed them on Cyrus, the Cyrix P-166 that is my current main Win 95 machine. My real main machine is now Princess, a Compaq Professional Workstation 5000 running NT 4.0, but for the moment, I do a lot of work on Cyrus as well. Both updates installed painlessly, although there were a few oddities. For instance, I had to go find the passwords to my Dial-Up network accounts, because the update lost the ones I'd saved.

The result is a real improvement. Internet access is much faster, and multiple Internet operations really work. We were able to simultaneously do two downloads, answer mail, and go look at another Web site without any slowdowns. That's quite an improvement from a free download.

This worked so well that Alex thought he'd apply them to Pentafluge, the rather-dated Pentium 60 machine with an Intel Pentium OverDrive processor that Larry Niven uses when he works here. The result was a disaster: whatever effect these upgrades had on Internet browsing, the Dial-Up network update 1.2 (TweakDUN) collapsed the internal network. Pentafluge could no longer connect to any of our other machines.

Alex uninstalled the upgrades. After about an hour, he was able to get the network restored. It wasn't easy. Among other things, TweakDUN set the network properties so that NetBEUI was no longer the default protocol. There were other problems, but eventually we had Pentafluge back on the network.

We defragged the disk drives and did some more tweaking. Then we tried the upgrades again. Big mistake. Once again, Pentafluge vanished from the network; and this time, possibly because we tried to do some adjusting without uninstalling TweakDUN, things got progressively worse. By the time we did the uninstallation, it was too late. Bottom line: I worked a day trying to get Pentafluge back on the network, to no avail. It would not work.

I decided that drastic action was required: it was time to boot up in DOS, nuke the Windows directory, and reinstall Win 95 from scratch. We've used Pentafluge as a test machine for a year, and there were remnants of programs that couldn't be uninstalled. Tons of DLLs in the system directory. Garbage files everywhere. That sort of thing. Cleaning house was indicated anyway, and it also seemed to be the only way to restore the network. There was only one problem: in order to reinstall Win 95, I would need the CD-ROM drive, and that CD-ROM drive wasn't visible unless I was running Win 95.

That shouldn't have happened. In theory, I have a panic boot disk for every machine. A panic disk should contain the drivers for the CD-ROM drive, Zip drive, and other important accessories. Unfortunately, I had changed CD-ROM drives without updating the panic disk.

Upgrading our software generates this month's tales of hope, horror, and glory.

Two possible remedies: I could try to find the specific CD-ROM drivers for this version of the Distributed Processing Technology (DPT) SCSI controller Pentafluge uses—it's an older SmartCache III—surely I have those here somewhere. Or call DPT. Maybe they have something that would let me access the CD-ROM. I considered calling Sony—it's a Sony CD-ROM drive.

But, in fact, as I was dithering, I found a copy of Sony.sys from DPT. It took about 10 minutes to fit up a CONFIG.SYS and AUTOEXEC.BAT—I'd completely forgotten how to do that—but eventually I got it done. The real trick is in getting the

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command-line parameters for Microsoft CD Extension (MSCDEX). They're in most DOS books, but I don't have many left.

Once I was sure the CD-ROM drive worked in DOS, I saved the entire Windows directory onto the Maxoptix glass drive and then deleted it on Pentafluge. Boot up in DOS and run Golden Bow Systems' Vopt, still the best disk defrag program I know of. Reboot in DOS. Then I installed Win 95 from a CD-ROM. Since I had an upgrade Win 95, I had to find the setup disk for Windows 3.11 and put it in the floppy drive before Win 95 would install. After that, it all went swimmingly.

Moments later, I had the network restored. I had a pleasant surprise: Pentafluge runs about five times faster than before. Programs load faster, and the system doesn't thrash about as much. Everything is crisper. I didn't do any benchmarks, so I have no objective measures, but it's more than noticeably faster, so much so that I am thinking of doing the same thing to Cyrus.

The moral of this story is that if you change hardware, don't wait for a crisis to update your panic disk. A second moral is, clean your Windows once in a while. It sure can make a difference.

SIGGRAPH IS IN TOWN. THIS IS the Special Interest Group on Graphics of the Association for Computing Machinery. It has become ACM's largest show (and presumably also their largest fund-raiser). If you have any interest in graphics, it's more than worth going to. There are classes from raw beginner to very advanced techniques, chances to use a supercomputer for an hour or so, and technical exhibitions.

Clean your Windows once in a while. It sure can make a difference.

Alas, the floor show is becoming indistinguishable from the Electronic Entertainment Exposition: lots of hype, flashing lights, and a general heat-and-noise level sufficient to drive me out of the room, although not before I saw more than enough to boggle my mind.

Some major impressions. First, the price of admission to the world of high-end graphics is low and falling. Intergraph and Compaq both had new boxes with supercomputer capabilities at under $12,000, and I don't say that lightly. You could create all the objects in *Jurassic Park* on either of these machines, and you might even be able to animate them. Rendering the final prints to movie quality still takes days on much larger machines, but you could create a show, render in TV-video quality, and have it to present to financial people with equipment and software costing no more than $25,000. This is astonishing.

Hewlett-Packard and Digital Equipment, and even Dell and Gateway 2000, are also getting into the high-end graphics-machine game. I fully expect that my estimated $25,000 for a professional system will be cut in half in no more than a year. Ain't competition wonderful?

Second, it's no longer a Silicon Graphics/Unix world. At least half the professional-level displays we saw on the floor at SIGGRAPH were run on NT platforms. A few years ago, there were essentially none. As David Em, our graphics associate who attended the show with me, puts it, "The era of SIGGRAPH as the Silicon-Graphics-and-everything-that-goes-with-it show is over."

Third, while most of the very high-end professionals are still using Softimage—a program developed for Silicon Graphics systems but now acquired by Microsoft and running on NT platforms—3D Studio Max, from Kinetix (a division of Autodesk), is catching up fast. Moreover, the current version of 3D Studio Max was designed to be an NT program and uses an interface that will already be familiar to AutoCAD users. This leads me to believe that design students are more likely to learn 3D Studio Max than Softimage.

Also, while the final cost of Softimage and 3D Studio Max with all the enhancements needed to bring it up to Softimage's power will be about the same, you can buy 3D Studio Max and enough plug-ins to get started for about half what you'll pay for Softimage. This is another big plus for students and beginners. *continued*

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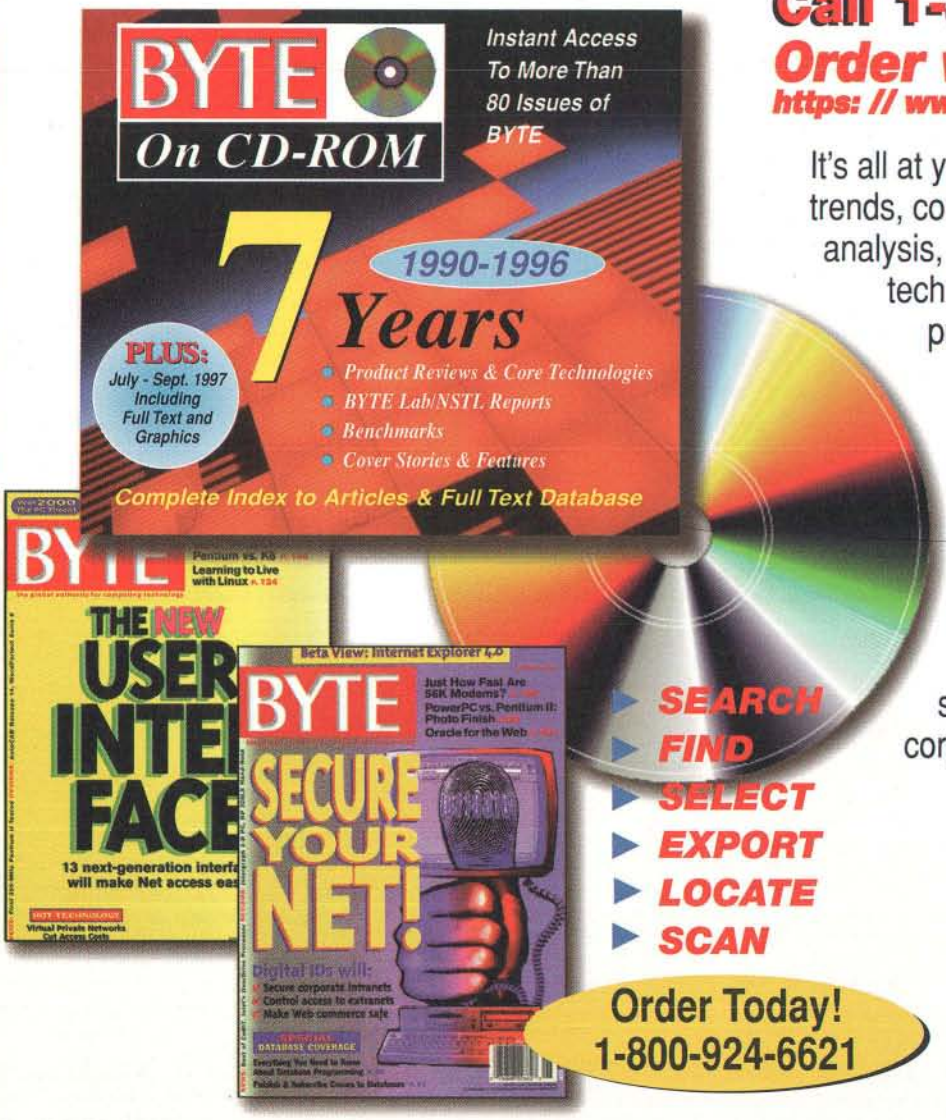

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It's an exciting world out there.

As I said, David Em, who knows much more about graphics than I do, attended SIGGRAPH with me. Look for more of David's observations in the Web Exclusive part of the column on the BYTE Web site. Incidentally, if you are interested in computer-generated art, you can see some of David's work at http://businesstech.com/art/emgallery.html.

While we're on the subject of graphics, CAD, and Web sites, if you don't know about Visio, you ought to.

Visio is a stand-alone application for making technical drawings and other artwork. It has its own development environment or can extend Microsoft's Visual Basic for Applications environment. It also knows about Microsoft Office, and you can use it in conjunction with any of its components, including Word.

Mostly, Visio has a number of smart templates, and if the set you need didn't come with the package you bought, it's probably available. Templates include architect, chemical, electrical, electronic, process plants, pumps, pipes, heating and ventilation—well, you get the idea. There are also abstract shapes suitable for making flowcharts and diagrams. If you work with computers and don't know about Visio, I bet you wish you did. Not only recommended, it's close to essential.

IF YOU'RE LOOKING FOR SOME unusal clip art on a Western theme, the classy RT Computer Graphics collections are now available on CD-ROM. Cowboys and Indians, traditional Navajo and other Santa Fe art, petroglyphs (genuine and humorous), plains Indian art, borders and images, it's all pretty neat. Look them up at http://www.rtcomputer.com. Next time I do a pass through my Web site, I'll probably include a few of these.

THE OLD GAME OF THE MONTH is the Deluxe Edition of Conquest of the New World, from Interplay. One tip: the Deluxe Edition has a feature known as the ancient temple of war. Find it and get control of it; it's worth almost any cost. Even if you can't control it, try to get the ownership in dispute, because it gives an enormous advantage to the side that possesses it.

The new game of the month is Imperialism, from Strategic Simulations. It's somewhat like Civilization II, but it takes place in the 1800s, which was the classic

PRODUCT INFORMATION

Conquest of the New World, Deluxe Edition $29.95
Interplay Productions
Irvine, CA
800-468-3775
714-553-6655
fax: 714-252-2820
http://www.interplay.com
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Olympus America, Inc.
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fax: 516-844-5339
http://www.olympusamerica.com
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Imperialism $49.99
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fax: 650-897-9956
http://www.ssionline.com
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Kai's Photo Soap $49.95
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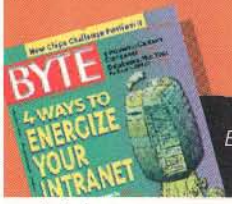

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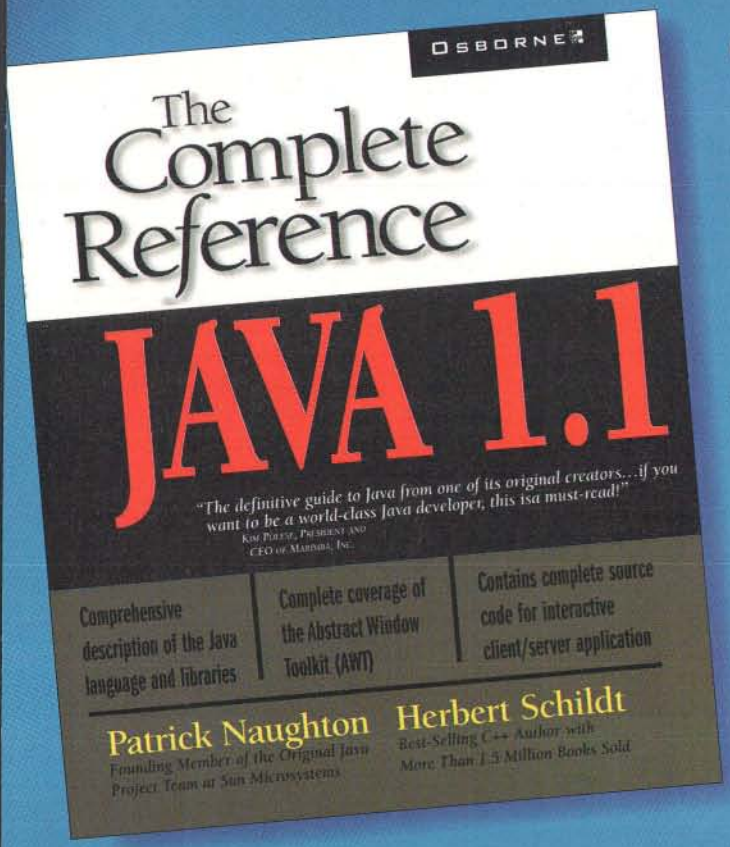

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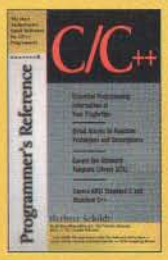

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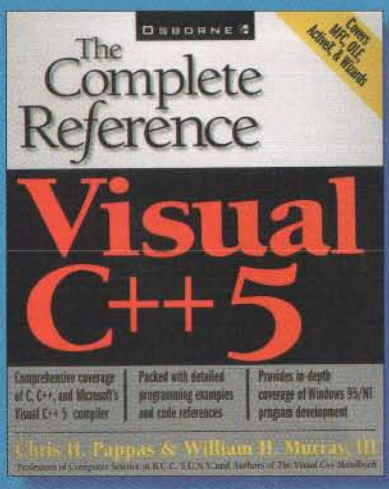

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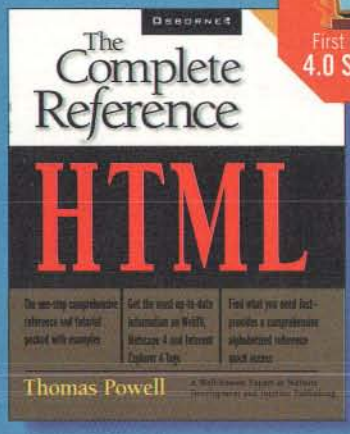

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The book of the month is my own, but you don't have to pay to read it.

The book of the month is my own, but you don't have to pay to read it. *The Strategy of Technology* was written in 1968 by Stefan T. Possony, Francis X. Kane, and Jerry Pournelle, and published by the University Press of Cambridge, Massachusetts. It was used as a textbook in all three service academies at one time or another and numerous times over the years in the Air War College at Maxwell AFB. It has been out of print for years, although photocopies circulated with my permission.

Recently, some young officers asked me to make it available. A professional Web designer, Arnold Bailey (abailey@bix.com), volunteered to turn it into good HTML, and so he did. You can find it, complete with partial revisions and notes, on my Web site at http://home.earthlink.net/~jerryp as well as a couple of other places. Fair warning, this is a cold war book, and while the principles haven't changed at all, nearly all the examples are from the Seventy Years War between the U.S.S.R. and Western civilization. It's an interesting example of how a book might be published on the Web; not fancy, but I think well done.

The computer book of the month is by Michael J. Hernandez, *Database Design for Mere Mortals* (Addison-Wesley Developer's Press, ISBN 0-201-69471-9). This is just what the title implies; if you keep lots of files and notes and wonder if there's a better way, you need a relational database, even if you don't know what one is. This book will help you understand the subject whether you work with Visual Basic, Access, FoxPro, Delphi, or whatever. It includes rules, views, and a good bibliography.

With luck, next month we'll have our new Pentium II system built. I've got all the parts, and we're getting a new ViewSonic monitor to go with it. Now to do my space council reports. B

Jerry Pournelle is a science fiction writer and BYTE's senior contributing editor. You can write to Jerry c/o BYTE, 29 Hartwell Ave., Lexington, MA 02173. Please include a self-addressed, stamped envelope and put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply. You can also contact him on the Internet or BIX at **jerryp@bix.com**. *Visit Chaos Manor at* **http://home.earthlink.net/~jerryp/**.

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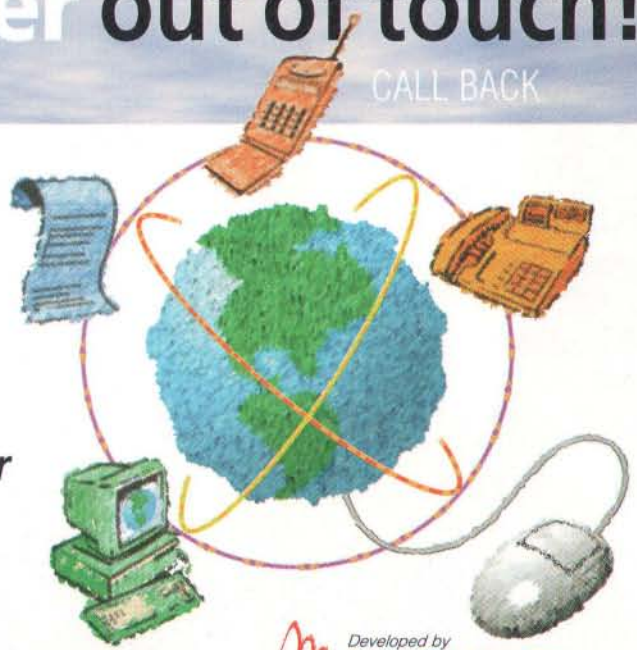
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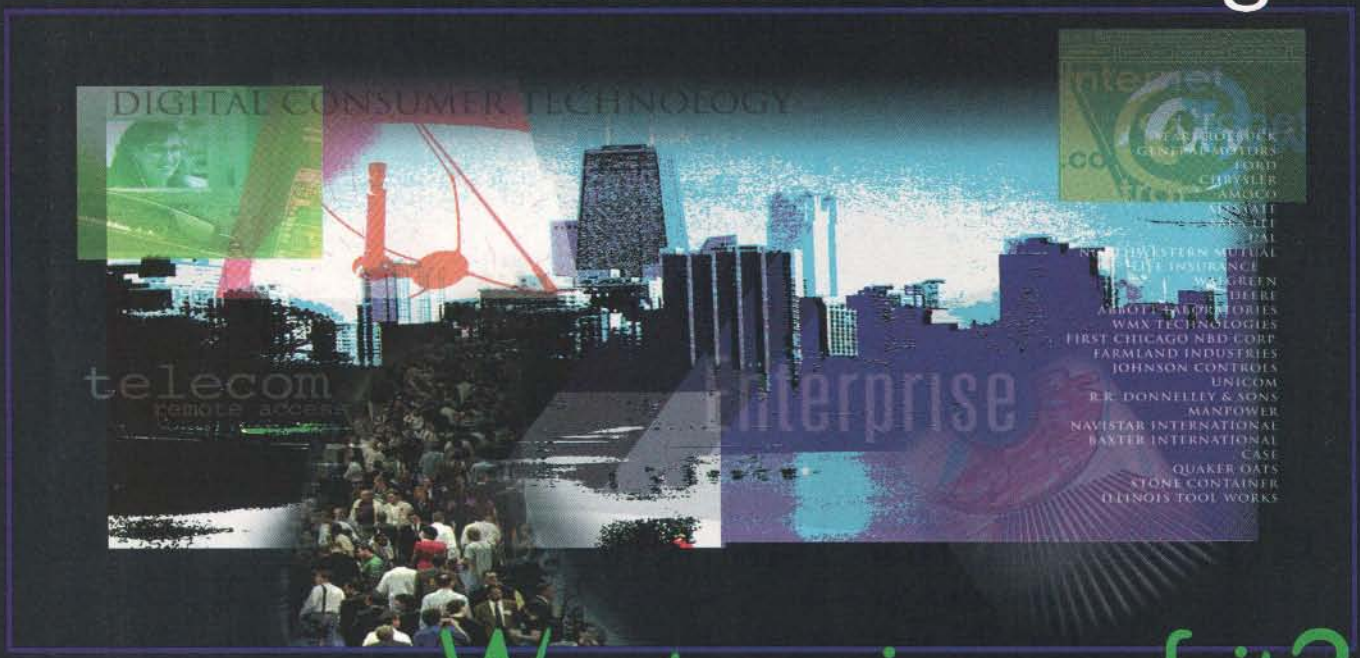

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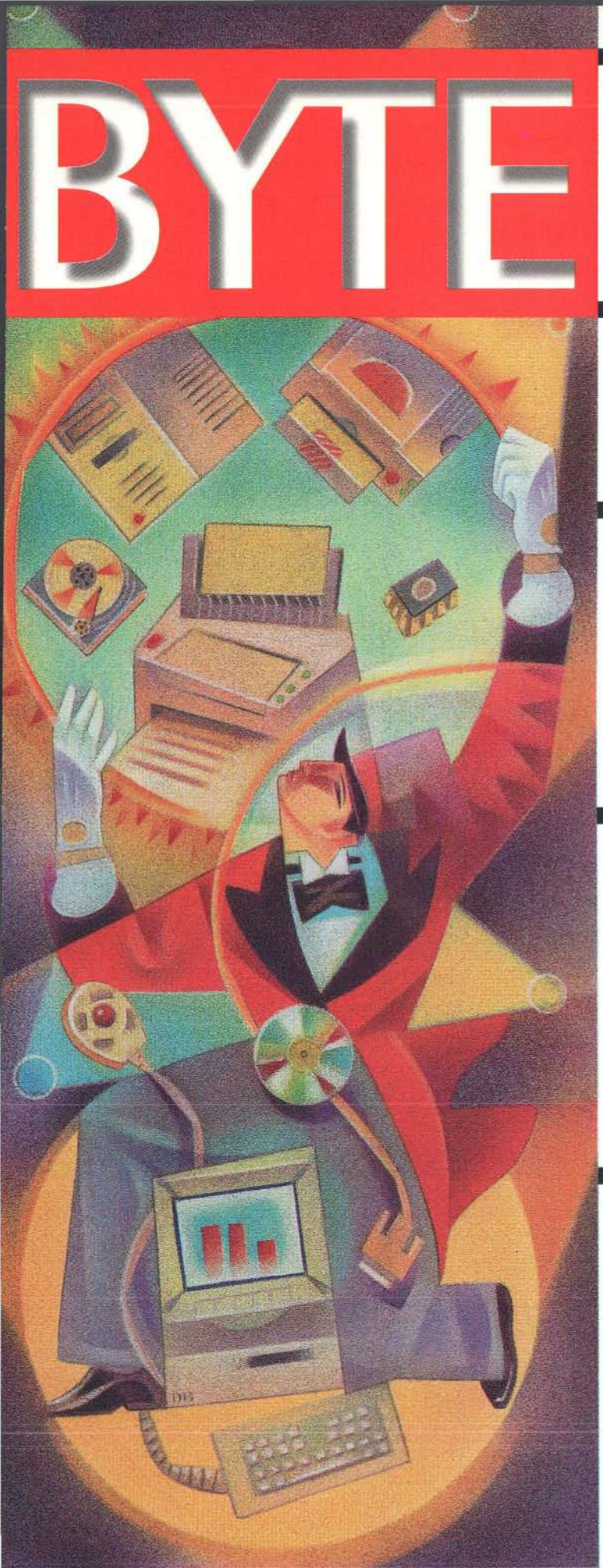

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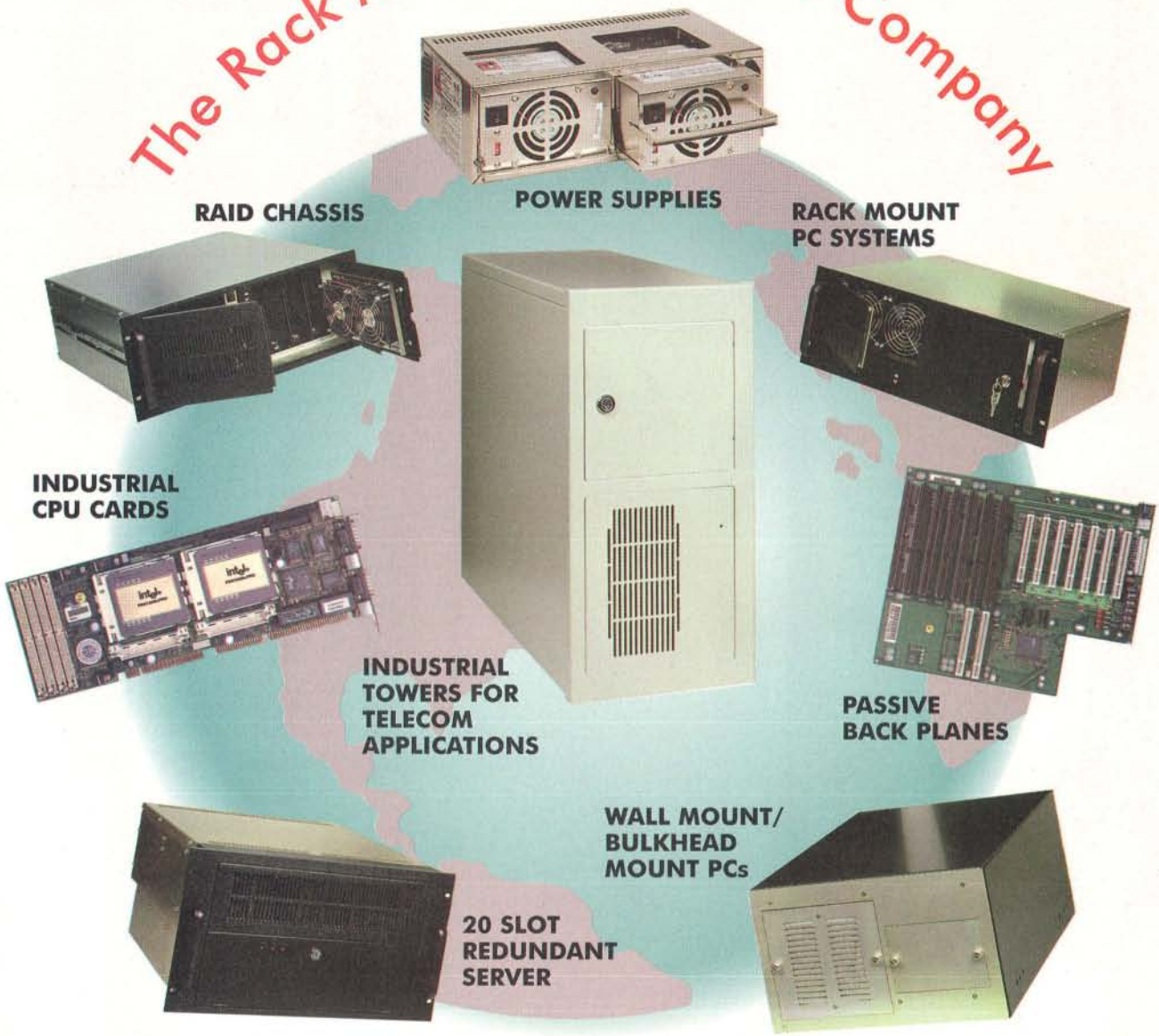

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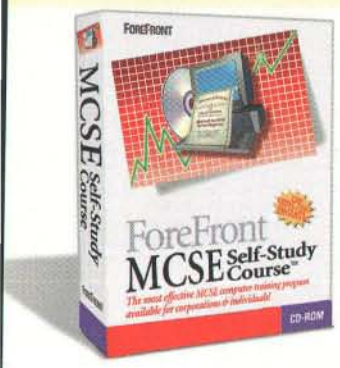

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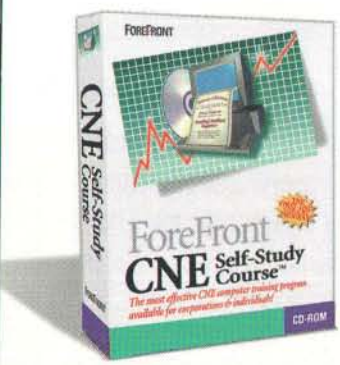

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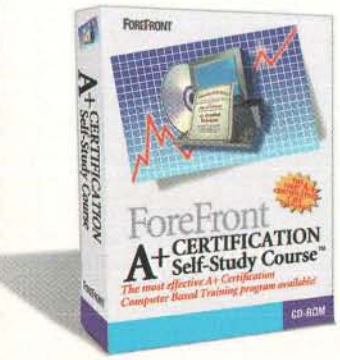

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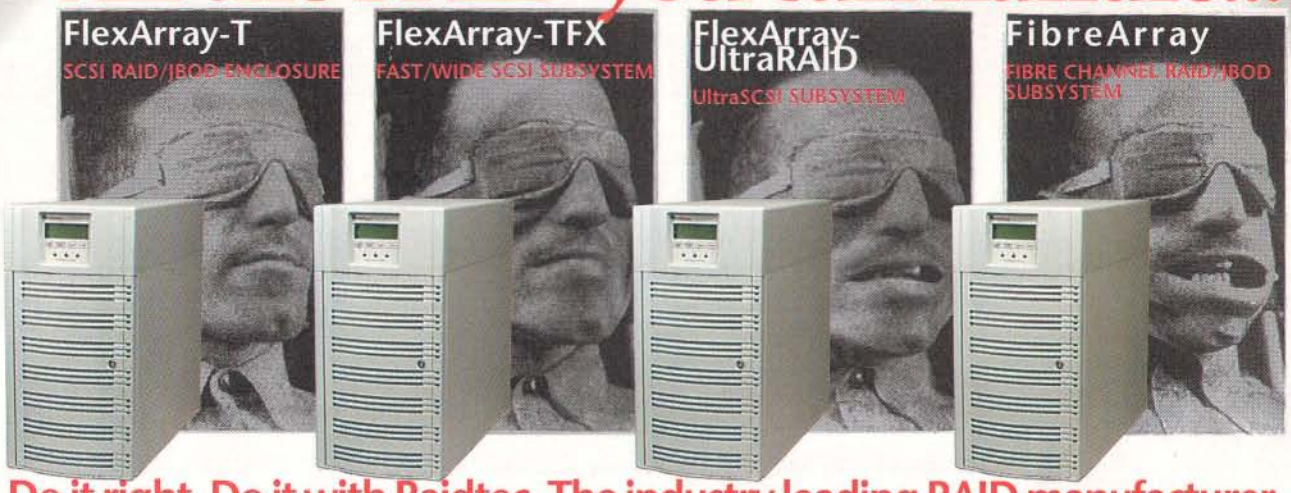

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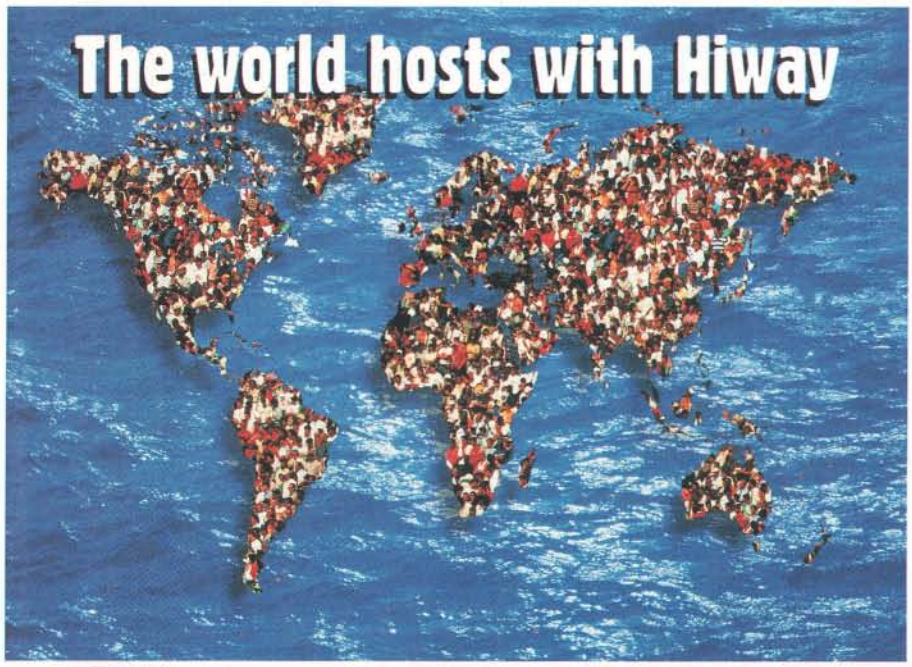

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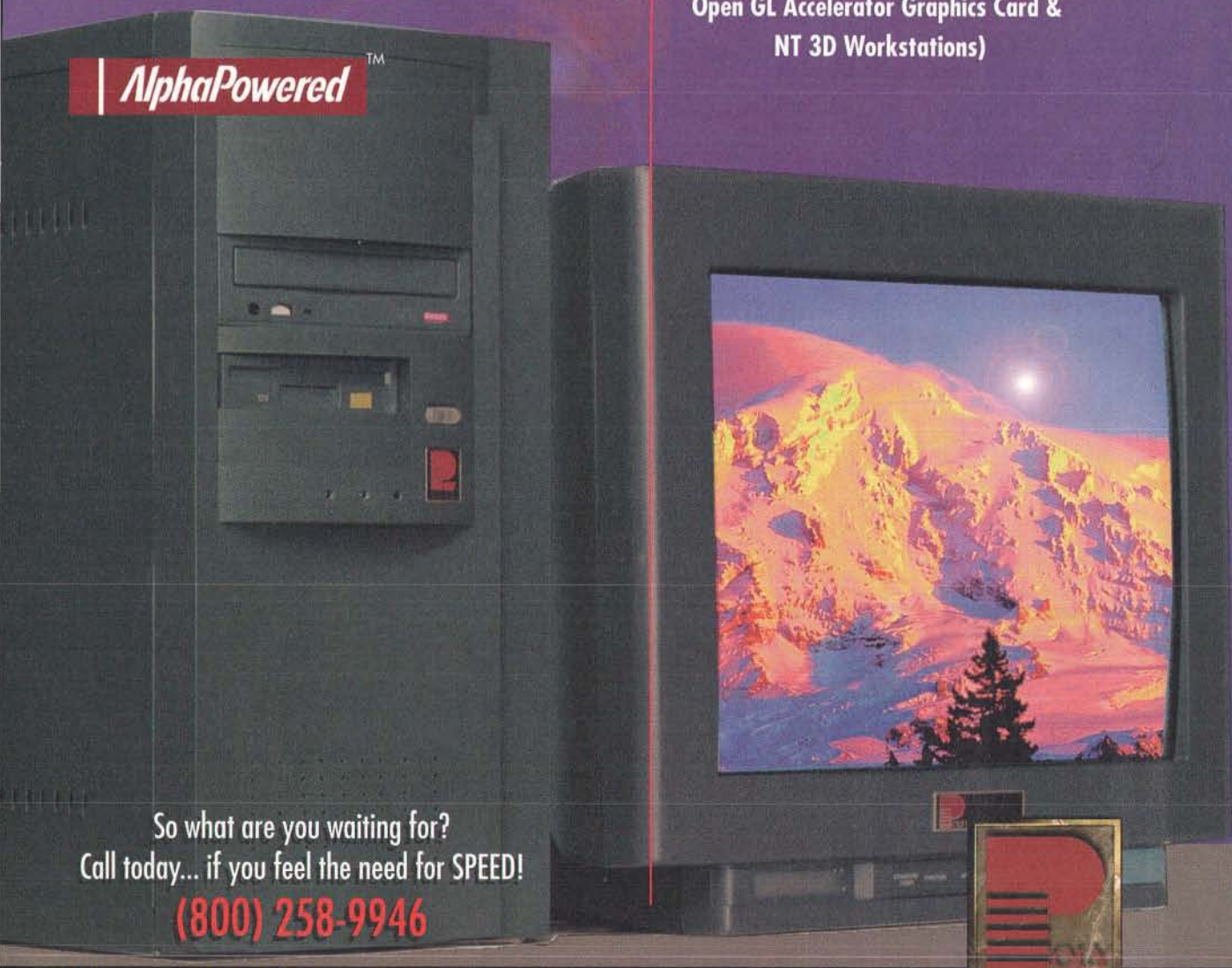

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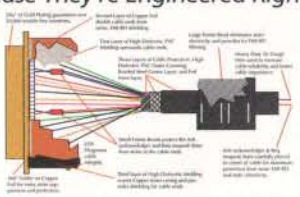

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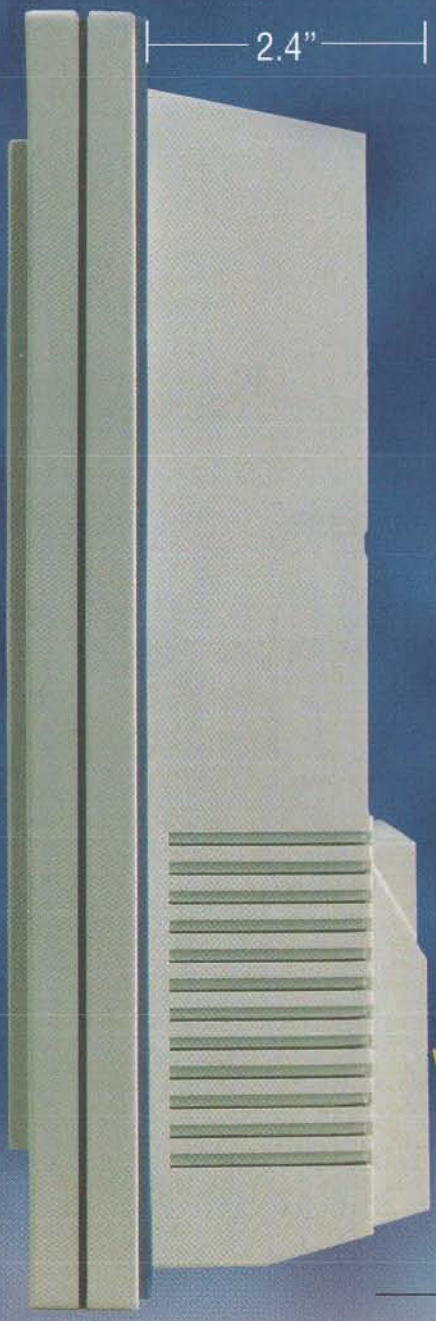

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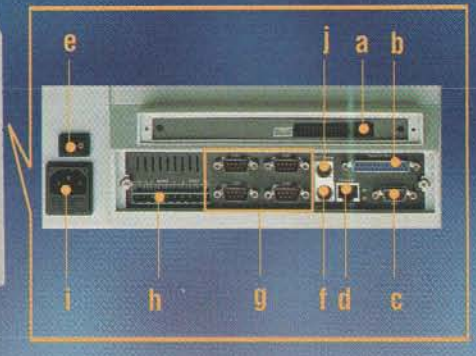

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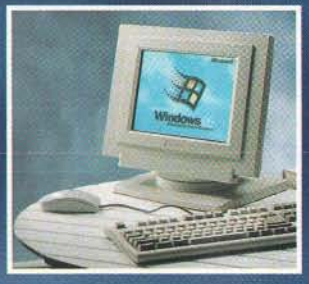

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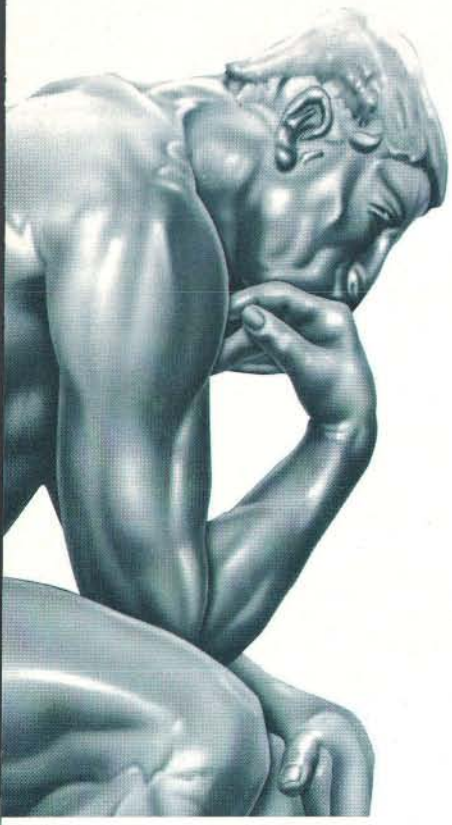

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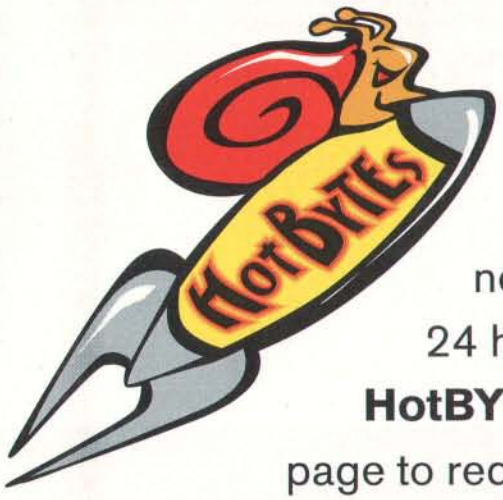

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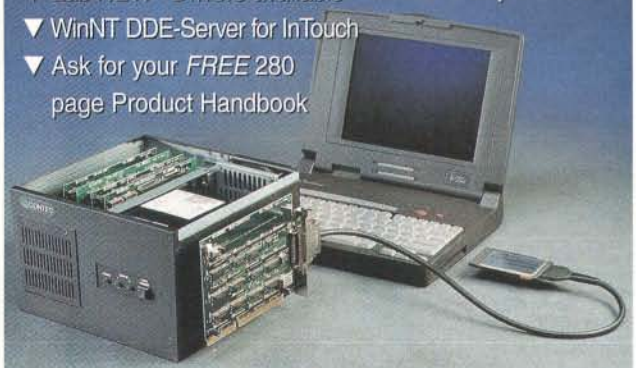

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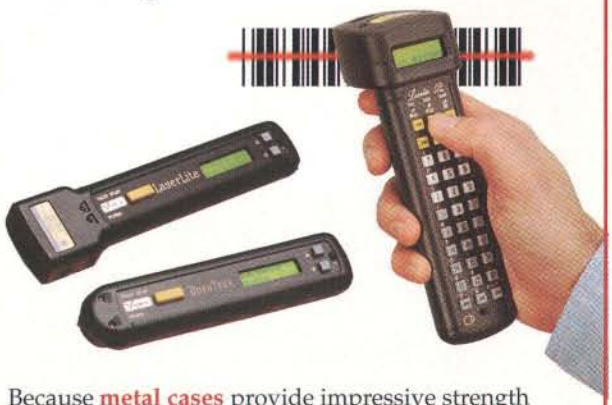

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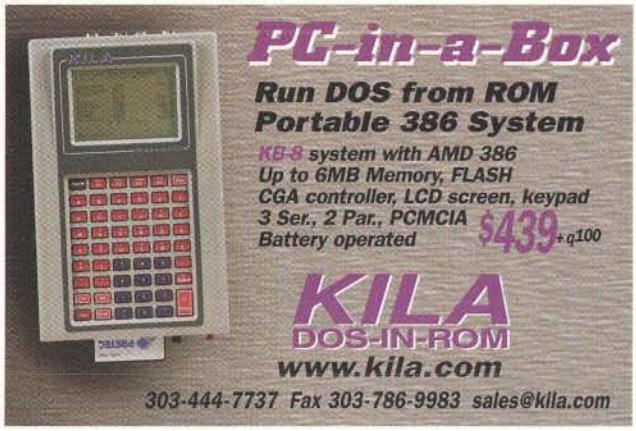

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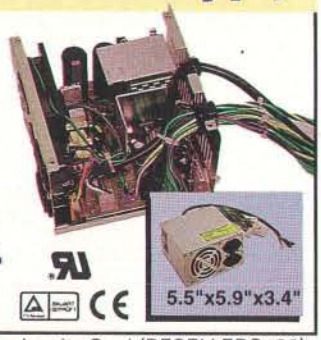

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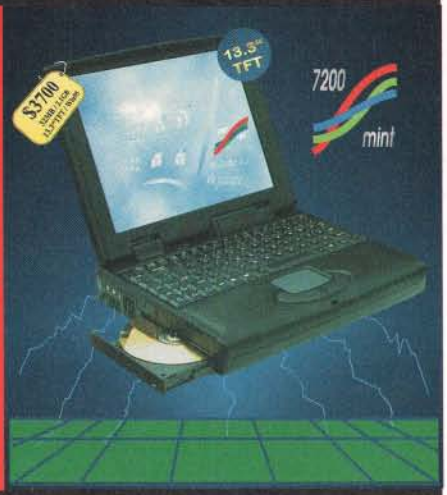

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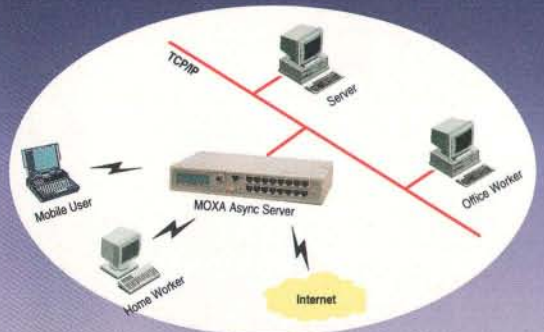

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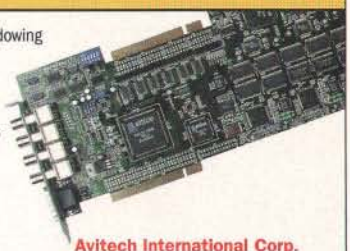

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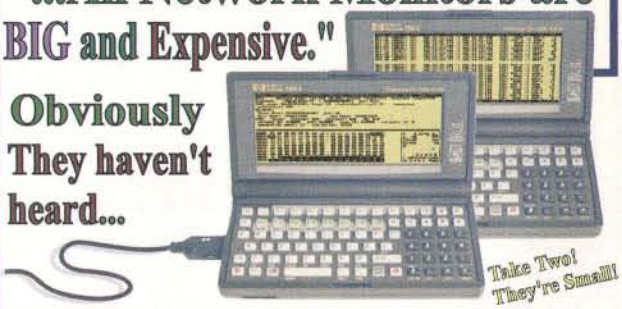

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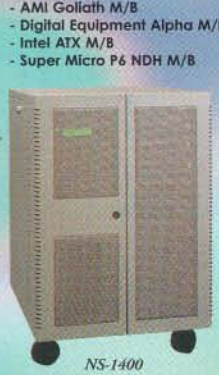

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98	VIDEX INC	150	541-758-0521
138-139	VIEWSONIC	65	800-888-8583 AGENT4007
	W		
467-468	WIBU SYSTEMS AG	32IS 15	+49-721-93172-22**
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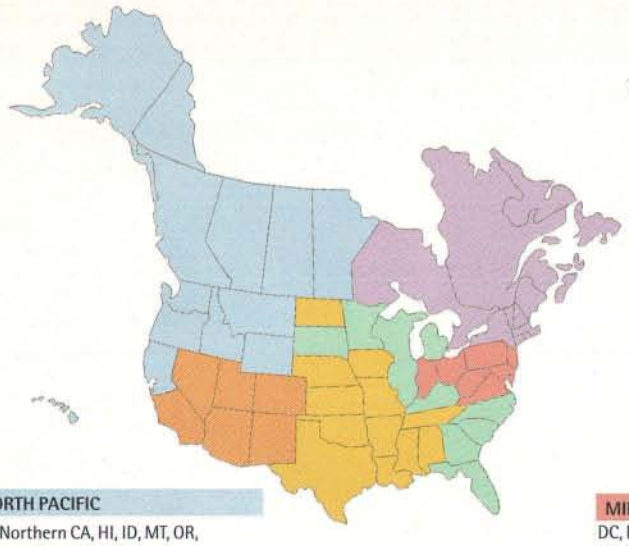

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For more information on any of the companies covered in articles, columns, or news stories in this issue, enter the appropriate inquiry number on the response card. Each page number refers to the first page of the article or section in which the company name appears.

INQUIRY NO.		PAGE NO.
	A	
1075	Acer America	106
991	Adobe Systems	159
	Alcatel	58
	Alpha Telecom	32IS 7
	AMD	18, 73
1076	AMS Tech	106
	Apple Computer	18, 87
	Applix	18
1003	Aqueduct	159
990	Artecon	159
1029	Articon Information Systems	32IS 28
	Asus	73
1053	Aventail	114
	Axent Technologies	81
	B	
1021	BinTec Communications	32IS 28
	Boothroyd Dewhurst	32IS 23
998	Borland International	159
1019	Brain Boxes	32IS 28
	C	
977	Canon Computer	159
	Casady & Greene	87
	CB Consultants	104M
	CCL/ITRI	32IS 7
1027	CE Infosys	32IS 28
	Centaur Technology	73
	Central Research Laboratories	32IS 3
1122	Cerious Software	129
1054	Check Point Software Technologies	114
1077	Chem USA	106
1030	Cherwell Scientific Publishing	32IS 28
	CIS Technology	32IS 7
1020	COM One	32IS 28
1078	Compaq Computer	106
1010	Computer Connections	32IS 28
	Conceptware	32IS 23
	Connectix	51
	Corel	18
1079	CTX International	106
	Cyrix	18, 73
	D	
1055	Data Fellows	114
992	DataLink	159
	Decision Dynamics	32IS 23
1080	Dell Computer	106
1001, 1052, 1081	Digital Equipment	18, 106, 114, 159
1000	Dimensional Insight	159
1028	Dr. Solomon's Software	
	E	
	Ecobalance/Ecobilan	32IS 23
1082	Empac International	106
1110	Entrust Technologies	121
	EORM	32IS 23
996	Eos Systems	159
983, 989	Epson America	159
	E-tech	32IS 7
1083	Eurocom	106
1084	Everex Systems	106
	F	
	FAPS	32IS 23
985	Franklin Electronic Publishers	159
1056	FTP Software	114
	G	
1119	G&A Imaging	129
	GA Seer Technologies	32IS 23
1085, 1086	Gateway 2000	106
	Gimpel Software	32IS 17
	Great Lakes Business Solutions	87
	H	
982, 1088	Hewlett-Packard	106, 159
1087	Hitachi	18, 106
	Hughes Communications	58
1022	HyperTec	32IS 28
	I	
981	IBM	159
1008	ICP Vortex	32IS 28
1025	The Imtec Group	32IS 28
1031	Information Technologies and Electronics	32IS 28
1015	Innovative Software	32IS 28
1120	Inso	129
994	Intel	18, 73, 159
1113	Interplay Productions	129
995	Iomega	159
	IPL	32IS 17
	J	
1118	Jasc	129
	K	
1041	KDS USA	159
1121	Kinetix	129
1089	Kiwi Computers	106
	KMPG Peat Marwick	104M
	L	
	Lernout&Hauspie	32IS 3
	Lockheed	58
1024	Logitech	32IS 28
	Loral	58
	Lotus Development	18
	M	
979	Matrox Graphics	159
	McCabe and Associates	32IS 17
	Mercury Interactive	32IS 17
1116	MetaCreations	129
	Metrowerks	101
1090	MicroExpress	106
1091	Micro International	106
1092	Micron	106
1057, 1062, 1109	Microsoft	81, 87, 114, 121, 125, 96NA 3, 104C
	Motorola	58
987	Mylex	159
	N	
	NCR Retail Services Group	104M
1093	NEC Computer Systems Division	106
1063, 1112	Netscape Communications	121, 125
	Network Information Technology	81
	Nortel/Cognition	32IS 23
1074	Number Nine Visual Technology	33
	O	
1114	Olympus America	129
	P	
1036	Paradigm Business Simulators	32IS 28
1033	Planetary Systems	32IS 28
976	Polywell Computers	159
1107	Pretty Good Privacy	121
	Prime View International	32IS 3
	Product Ecology Consultants	32IS 23
	Programming Research	32IS 17
	Pure Atria	32IS 17
	Q	
978	Quantum	159
	R	
1058	Raptor Systems	114
986	RDI Computer	159
	Reliable Software Technologies	32IS 17
	Restaurant Consulting Services	104M
1108	RSA Data Security	121
1124	RT Computer Graphics	129
	S	
	Savantage	32IS 23
1094, 1095	Sceptre Technologies	106
993	Seagate	159
1059	Secure Computing	114
1096	Sharp Electronics	106
1026	Sicon-Socomec	32IS 28
	Siemens Nixdorf	32IS 23
1032	Silux	32IS 28
1097	Sony Electronics	106
1106	Sound Vision	34
	Spinwest	32IS 23
1115	Strategic Simulations	129
1060	Sun Microsystems	114
	SunTest	32IS 17
	Symantec	121
	T	
1098	Tatung Company of America	106
	Teledesic	58
	Texas Tech University	32IS 23
1099	Toshiba America Information Systems	106
984	Toshiba Imaging	159
1002	Traveling Software	159
1004	TravRoute	159
1042	Trellix	37
1061	Trusted Information Systems	114
	Turtle Bay	32IS 23
	V	
	Verilog	32IS 17
	VersaNet	32IS 7
	Vicious Fishes Software	87
1123	Visio	129
1013	Visualizing Ideas	32IS 28
	W	
997	WexTech	159
1100	WinBook	106
	Z	
	ZyXel Communications	32IS 7

IS pages appear only in the International edition. NA pages appear only in the North America edition. C and M pages appear only in the Reseller edition.

www.byte.com

What's New

Hardware

A 600-MHz Alpha workstation, Unix notebooks, Java development tools, and remote network management software.

PREVIEW

PolyAlpha PC
$10,661

Enter 976 on Inquiry Card.

Polywell Computers
South San Francisco, CA
800-999-1278
415-583-7222
http://www.polywell.com

The Fastest Box on the Block

Digital Equipment's Alpha chip is not just for servers anymore, though it is still not your typical desktop processor. The latest 21164 processor can run at 600 MHz, roughly twice the speed of most competitors' chips. The typical user won't need this kind of speed to run Microsoft Office or read e-mail, but this level of processing power promises to push high-end graphics or database applications to new heights.

I looked at a Polywell PolyAlpha PC running the new 600-MHz chip with a 2-MB L3 cache, 128 MB of RAM, a 4.5-GB Ultra-Wide SCSI hard drive, and a 4-MB Matrox Millennium PCI graphics card. This configuration costs $10,661, though most users will probably opt for a more powerful graphics card, should they use this system for animation, 3-D rendering, and such graphics applications.

The system runs either Unix or Windows NT. Unix systems have been shipping since July, but the system I saw is among the first running NT. I ran the native Alpha BYTEmark benchmark on this system (see "A Chip Off the Old Block" on page 18), which tests the raw processing power of the CPU, and got the highest numbers from any NT desktop system we've tested to date.

If over $10,000 is excessive for this kind of processing power, a 533-MHz system will cost $4300 less, and the 500-MHz Alpha system will cost $5200 less. The price of the 21164 chip will eventually come down, and the price of the system with it, but for now, this is likely the most screaming processor on the market.

–Jason K. Krause

Add-ins

Video Graphics TV Kit for PCs

MATROX'S NEW GRAPHICS, VIDEO AND TV Kit combines the Matrox Mystique 220 3-D and video accelerator with 4 MB of SGRAM and video-capture and TV-tuner options to let you capture and edit video. Or, you can simply watch TV on your PC. The system, which includes video-editing software, games, and other titles, sells for $379.
Contact: Matrox Graphics, Dorval, Quebec, Canada, 800-361-1408 or 514-969-6300; http://www.matrox.com.
Enter 979 on Inquiry Card.

Printers

Desktop Printing in a Small Package

CANON'S BJC-80 OFFERS COLOR PRINTing in a package that's not just affordable, but portable, too. The Canon BJC-80 ($299) is a 3-pound,

four-color ink-jet printer that is 11.8 inches wide, 6.2 inches deep, and 2.2 inches high. It is capable of printing on paper up to 8 inches wide. The BJC-80 achieves 720 by 360 dpi with Canon's Drop Modulation Technology that allows the print head to control the size of dots as it prints. It is rated for 4-page-per-minute printing in black ink and 2 pages per minute in color.
Contact: Canon Computer Systems, Costa Mesa, CA, 800-848-4123 or 714-438-3000; http://www.ccsi.canon.com.
Enter 977 on Inquiry Card.

Scanners

Digitize Images Faster

THE HP SCANJET 6100C ($799) SPEEDS the scanning process, capturing images with a single exposure, and

hardware-accelerated image processing takes the guesswork out of scanning. A trichromatic beam captures the full spectrum of color in one pass across an image, and a processing chip, new to Hewlett-Packard's line of scanners, performs color matching, more accurate gray-scale output, and basic image-processing tasks.
Contact: Hewlett-Packard, Palo Alto, CA, 800-722-6538 or 650-857-1501; http://www.hp.com.
Enter 982 on Inquiry Card.

Bigger, Bolder Scanning

THE EPSON EXPRESSION 836 XL IS A SCANner for graphic designers and engineers. It can scan images the size of a tabloid newspaper, such as posters, blueprints, or large-format prints, or can batch-process multiple smaller images. It has 800- by

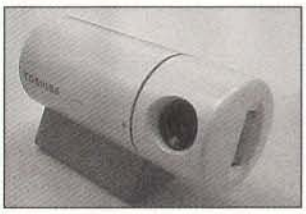
PHOTOGRAPH: MICHAEL MAYO © 1997

1600-dpi optical resolution with 36-bit color and an auto-focus lens, rather than fixed-focus. The Expression 836XL makes scans in one pass and can scan images of up to 12.2 by 17.2 inches. With the bundled SilverFast scanning software, you can optimize image output with control over range, gradation, color balance, contrast, brightness, highlights, halftones, and shadows. The basic unit costs $2500. For $3000, you can get one that can process slides, 40 at a time.
Contact: Epson America, Torrance, CA, 310-782-0770; http://www.epson.com.
Enter 983 on Inquiry Card.

Videoconferencing

Get the Picture

THE TOSHIBA IK-MM1 BRINGS HIGH-RESolution imaging to the portable-computer environment for $139. It features a CCD image sensor with a fixed-focus lens, automatic white balance, 512- by 492-pixel resolution, and a video-capture rate of 30 frames per second. The IK-MM1 has analog NTSC video output and works with most video-capture cards. It has no audio capabilities, which means you need a separate microphone to conduct an audio/video videoconference.



Contact: Toshiba Imaging Systems, Irvine, CA, 714-461-4984; http://www.toshiba.com/pccam.
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PC Cards

King of the PIMs

REX IS A PIM IN A PC CARD FORM FACtor. Use it to download information from PIMs such as Microsoft's Outlook, Schedule+, Lotus Organizer, and Starfish's Sidekick. You can access the data anywhere on REX's 9-row, 30-column LCD screen. REX has 128 KB of flash ROM, fits into a Type II PC Card slot or uses a serial-port adapter to access PCs, and uses Starfish's TrueSync synchronization software for accessing data. It weighs 1.4 ounces, measures ¼ inch thick by 2 inches wide and 3 inches deep, and runs on two lithium-ion batteries. The estimated street price of the REX PIM ranges from $129.95 to $179.95.

Contact: Franklin Electronic Publishers, Burlington, NJ, 609-386-2500; http://www.franklin.com.
Enter 985 on Inquiry Card.

Monitors

Get the Whole Picture

A 19-INCH MONITOR FROM KDS USA, THE Visual Sensations VS-19, presents 18.8 inches of screen space priced at $999. It has a horizontal scanning frequency of up to 95 kHz with a picture resolution of up to 1600 by 1200 pixels at 75 Hz. It needs an adapter for use with a Mac and supports Plug and Play on Windows 95 machines.
KDS USA, Garden Grove, CA, 714-379-5599; http://www.kdsusa.com.
Enter 1041 on Inquiry Card.

Systems

The Power Paradigm

THE POWERDIGM XSU FEATURES MICRON'S Samurai chip set, which promises higher system bandwidth and support for Ultra SCSI, Gigabit Ethernet, or Fibre Channel I/O. Slots on the motherboard include one (66-MHz) 64-bit PCI, two (33-MHz) 32-bit PCI, and two ISA. The system supports up to two Pentium II CPUs and comes with your choice of a Diamond Fire GL or Number Nine Revolution 3D video card. Standard features include the Pentium II, a 512-KB L2 cache, up to 384 MB of RAM, a 24× CD-ROM drive, and up to a 9-GB Ultra SCSI hard drive. The system starts at $5199 with a single processor.
Contact: Micron Electronics, Nampa, ID, 800-209-9686 or 208-893-3434; http://www.micronpc.com.
Enter 980 on Inquiry Card.

New Network Computers

NOT EVERYONE ON A CORPORATE NETWORK is a power user. IBM's new Series 1000 network computers are built to be cost-effective alternatives to a PC. They have e-mail and Internet and intranet access. They can run Java applets and applications as well as execute Windows applications via multiuser implementations of Windows NT on a PC server. They support 3270 and 5250 terminal applications and work with applications on AIX and Unix servers using X Window System server support.
Contact: IBM, Somers, NY, 800-426-7080 or 416-383-5152; http://www.ibm.com/nc.
Enter 981 on Inquiry Card.

Cameras

Making Picture Taking Simple

EPSON'S PHOTOPC 600 DIGITAL CAMERA ($799) captures images at XGA resolution (1024 by 768 pixels), with an auto-focus lens and built-in ColorTrue image-processing software for fine-tuning color accuracy, saturation, balance, and contrast. Auto-exposure and a built-in automatic flash simplify picture taking, a built-in LCD monitor plays back photos, and the camera will print photos directly to the Epson Stylus Photo color ink-jet printer without downloading them first to a PC. The printer's estimated street price is $499, and the $69 Stylus Photo Direct Kit includes the implements necessary for direct printing without a PC.
Contact: Epson America, Torrance, CA, 310-782-0770; http://www.epson.com.
Enter 989 on Inquiry Card.

Portables

Portable Sun Workstations

THE ULTRABOOK ($11,995), FROM RDI Computer, offers Unix workstation performance in a portable notebook. This 7.4-pound lithium-ion-powered notebook has a 200-MHz UltraSPARC processor, a 14.1-inch active-matrix LCD, and a 9-GB EIDE hard drive for portable processing power. It includes 32 to 512 MB of memory and a PCI-based ATI Rage LT Sun Creator 2-D or 3-D graphics accelerator. The UltraBook runs unmodified Solaris 2.5.1 or 2.6 and is compatible with Sun Microsystems workstations.

Contact: RDI Computer, Carlsbad, CA, 760-929-0992; http://www.rdi.com.
Enter 986 on Inquiry Card.

Hard Drives

High-End Hard Drives

THE QUANTUM ATLAS III AND VIKING II have the disk space and throughput that high-end workstations and servers need. Both support the Ultra2 Low Voltage Differential SCSI for high bus transfer rates, and the 7200-rpm Atlas III drives support Fibre Channel–Arbitrated

Loops. The Atlas III series (from $749 to $1995) offers 4.55-, 9.1-, and 18.2-GB hard drives, and the Viking II series ($595–$895) has 9.1- and 4.55-GB drives. The Viking II series is targeted at the PC server and workstation environment. The Atlas III is geared for OLTP, data warehousing, and multisystem clustered environments.
Contact: Quantum, Milpitas, CA, 408-894-4721; http://www.quantum.com.
Enter 978 on Inquiry Card.

Servers

Thin Is In

THE AUTONET ($995), FROM MYLEX, IS A platform-independent, embedded Plug and Play network server engine, otherwise known as a "thin" server. Based on the NetEngine architecture, which uses open RISC, ASIC, I/O, and LAN architectures, the AutoNet will support the addition of high-performance SCSI peripherals to a LAN architecture. The AutoNet has the form factor of a 3½-inch disk drive. You can use it as a file server or to add storage products to a network. You can use the AutoNet to perform functions that were previously performed by more expensive file servers, but

without requiring NICs, large amounts of RAM, or NOS licenses, as do other file servers.
Contact: Mylex, Fremont, CA, 510-608-2222; http://www.mylex.com.
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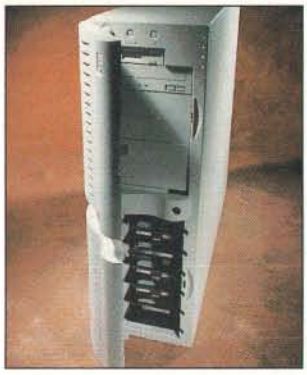
Continuing the Revolution

BUILDING ON THE ARCHITECTURE OF THE ALR Revolution Quad6 and Revolution 6×6 servers, the Revolution 2XL ($3495) supports dual Pentium Pro



or Pentium II processors and a host of the latest server features. The Revolution 2XL, an enterprise-class server, has a 64-bit SMP parity path between processor, cache, and memory; integrated PCI Fast Wide UltraSCSI and PCI graphics controllers; and two 365-W power supplies for load sharing. A PCI/EISA bus architecture offers fast peripheral performance, while maintaining backward compatibility with EISA legacy systems.
Contact: Advanced Logic Research, Irvine, CA, 714-581-6770; http://www.alr.com.
Enter 988 on Inquiry Card.

Storage

Highly Scalable RAID Solutions

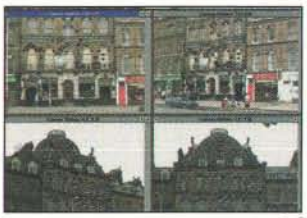
THE LYNXSTAK SERIES 2000 RAID SYSTEM scales from simple 4-GB RAID protection up to backup protection for workgroup environments with terabytes of backup disk space. Each LynxStak controller supports as many as 14 Artecon Lynx drive subsystems, for up to 118 GB of usable capacity. Ultra Wide SCSI channels provide up to 40-MBps burst and 33-MBps sustained data transfer rates. Hot-swap removable RAID controllers, disk drives, fans, and power supplies help eliminate downtime, and the RAID controller achieves 4600 I/Os per second. Prices start at $9710 for a 12-GB configuration.
Contact: Artecon, Carlsbad, CA, 619-931-5500; http://www.artecon.com.
Enter 990 on Inquiry Card.

SOFTWARE

Imaging

Digitize Real-World Objects

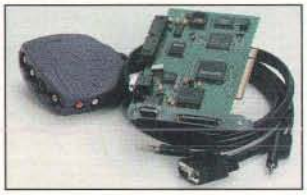
PHOTOMODELER PRO 3.0 ($795) GENERATES 3-D models of real-world objects and scenes for architecture, accident-reconstruction, forensics, archaeology, engineering, and 3-D-animation applications. To construct 3-D models of real-world objects, shoot two or more photographs of an object or scene from different angles and mark points on one photograph that correspond to points in another picture. Scan



or digitize the photographs, and let PhotoModeler process the data. You can export the resulting 3-D models into CAD, animation, or graphics software. A few new features include support for new file export formats, enhanced photo-texturing, cylinder and curve modeling, and multimedia tutorials.
Contact: Eos Systems, Vancouver, British Columbia, Canada, 800-782-5974 or 604-732-6658; http://www.photomodeler.com.
Enter 996 on Inquiry Card.

PC Camera and Software

INTEL'S CREATE AND SHARE LETS YOU TAKE snapshots from your PC, create short videos, or make video phone calls over the Web and regular phone lines. The program comes in three versions—USB, PCI, and PCI with built-in modem—ranging in



price from $199 to $349. Applications include photo-enhancement software, NetCard (for creating e-mail messages with images and sound), Kai's Power Goo for shrinking and morphing images, and video phone. It also includes an imaging camera that sits on top of a 90-MHz Pentium (or better) PC.
Contact: Intel, Santa Clara, CA, 800-538-3373 or 916-377-7000; http://www.intel.com.
Enter 994 on Inquiry Card.

Postproduction for Home Movies

FEED VIDEO INTO YOUR COMPUTER AND EDIT and add special effects with Iomega's Buz multimedia production software for under $200. The Buz kit includes in and out connector cables for S-video, composite video, and stereo audio systems, and can output finished product to videotape. Buz consists of a video-capture card, an UltraSCSI controller, and software. It is compatible with PCs and Macs, and can accept not only video input, but also data from any SCSI device.
Contact: Iomega, Roy, UT, 801-778-1000; http://www.iomega.com.
Enter 995 on Inquiry Card.

Programming

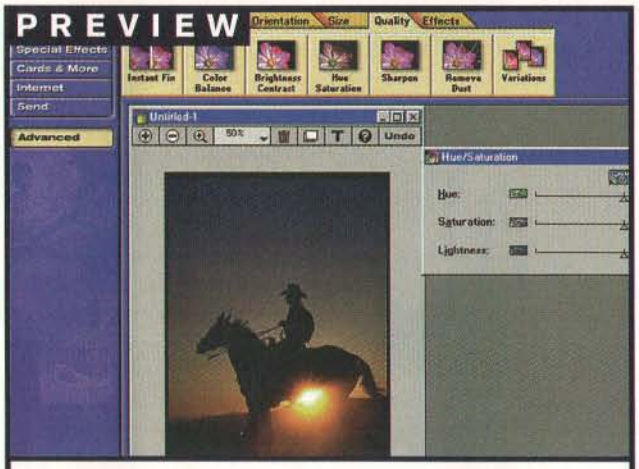
Java Development Tools

BORLAND'S JBUILDER FAMILY OF VISUAL development tools for Java, JBuilder Standard, JBuilder Professional, and JBuilder Client/Server Suite feature a JavaBean creation component, a scalable database architecture, and visual development tools. These Java development environments offer support for JavaSoft's JDK 1.1, JDBC, and the JavaBeans component model for producing Java applications, applets, and JavaBeans. JBuilder's open environment also supports 100 percent Pure Java, JFC, AFC, RMI, CORBA, JDBC, ODBC, and most major corporate database servers. JBuilder Standard has an

estimated street price of $99.95. Owners of other Borland tools can purchase JBuilder Professional for $249.95, and owners of competitive tools can purchase JBuilder Professional for $299.95.
Contact: Borland, Scotts Valley, CA, 408-431-1000; http://www.borland.com.
Enter 998 on Inquiry Card.

Build a More Helpful Application

ANSWERWORKS ($795) IS A NATURAL-language interface for building help files in an application. The program can interpret queries you type in and matches keywords from the question to the most relevant topics stored in the application's help file. For developers, the AnswerWorks project wizard guides them through the process of creating help topics. The program automatically generates end-user project files (NJP, LIM, and NMP files) and has intelligence built in for extracting keywords from a sentence keyed into a help program. AnswerWorks runs on Windows 3.1, 95, and NT; supports six languages; and can be given a custom interface.
Contact: WexTech Systems, New York, NY, 212-949-9595; http://www.wextech.com.
Enter 997 on Inquiry Card.



PhotoDeluxe 2.0
$49

Enter 991 on Inquiry Card.

Adobe Systems, Inc.
San Jose, CA
800-888-6293
408-536-6000
http://www.adobe.com

Photo Editing Made Easier

Adobe's PhotoDeluxe 2.0 image-editing software adds a host of features designed to appeal to both novice and experienced users. Although that sounds like a bit of a tightrope act, Adobe manages to pull it off. I previewed a beta version of PhotoDeluxe for Windows, but Adobe will also release a Mac version.

PhotoDeluxe's revamped user interface has visual cues that present functions in a more logical way to the end user, and Guided Activities in the program now require fewer steps. These improvements make the program more approachable and easier to follow for first-time and occasional users. Key tasks, such as Red Eye removal or edge selection, are vastly improved and automated for quicker execution. However, I think that Microsoft's PictureIt does a slightly better job at quickly outlining shapes. Other additions include the powerful PhotoShop clone tool, better text manipulation, and more snazzy special-effect filters.

For those who don't want to be led by the hand, PhotoDeluxe's Advanced mode is also beefed up, and it is easier to switch from the Guided Activities into the Advanced mode. In either mode, you can now access the Internet (Internet Explorer is built in) to send photos or get onto the Adobe Web site and download new Guided Activities. You can also make screen savers, e-mail cards, and slide shows out of photo projects.

Other notable features include Storm's EasyPhoto Organizer, plenty of project templates, and MMX support. PhotoDeluxe 2.0 is a winner, offering both creative power and usability. **–Jon Pepper**

Compression

File-Compression Technology

RMX TECHNOLOGIES HAS DEVELOPED Rush, an encoding technology that, RMX claims, can shrink some files by up to 95 percent of the original size. RMX has kits available, starting at $5000, for developers who want to use this technology. Rush is able to encode parts of a file's data structure without mathematical compression, though you can use standard math-based compression on Rush-encoded files to further reduce file size. Rush is tailored to shrink graphics files. You can view the files with most Web browsers or through plug-ins.
Contact: RMX Technologies, Ottawa, Ontario, Canada, 613-749-1400; http://www.rmx.com.
Enter 999 on Inquiry Card.

Disaster Recovery

Survive a Network Crash

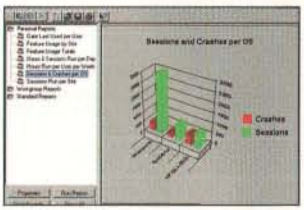
SEAGATE'S BACKUP EXEC FOR WINDOWS NT is backup software that, with its Intelligent Disaster Recovery module, provides recovery for your server after hardware failure. Backup Exec automates backup operations and can recover critical data in the event of a crash without reinstalling the OS. Fault-tolerant backup processing maintains backup integrity by rerouting jobs in the event of system, medium, or device error. With support for Microsoft's COM architecture, Backup Exec can

integrate with applications from third-party storage management vendors. The single-server edition costs $695, and the enterprise edition is $1395.
Contact: Seagate Software, Heathrow, FL, 800-327-2232 or 407-531-7500; http://www.seagatesoftware.com.
Enter 993 on Inquiry Card.

Development

Better Beta Testing

AQUEDUCT PROFILER ($20,000) ANSWERS the questions on every beta tester's mind: How are people using an



application, who is using it, how long they are using it, and when does it crash? Written for SunOS, HP-UX, and Windows NT and 95 applications, it is integrated into an application by adding library calls to the source code. It automatically e-mails user activity information from the application to the developer as ASCII text, and a reporting tool puts the data into simple graphs, pie charts, or tables quantifying the ways beta users deployed the application.
Contact: Aqueduct, Menlo Park, CA, 650-463-8700; http://www.aqueduct.com.
Enter 1003 on Inquiry Card.

Analysis

Dive Into Your Database

DI-DIVER ($1000) TAKES ODBC-COMpliant relational database files or flat ASCII files and turns unfathomable amounts of data into functional reports and graphs. DI-Diver supports HTML for accessing information across the Web and intranets, allowing reports to be shared on-line. The interface supports more than 100 analytical functions and can create reports with one mouse-click of the "report" button.

Contact: Dimensional Insight, Burlington, MA, 617-229-9111; http://www.dimins.com.
Enter 1000 on Inquiry Card.

Software Update

Intel has introduced a unified Windows NT and Novell NetWare client/server virus-protection version—5.0—of **LANDesk Virus Protect** ($1495). This release provides protection with real-time background scanning of incoming data and an integrity shield that secures executable files with write protection. Integrity verification scans modified files to limit virus propagation. Centralized management works across all Windows platforms as well as NetWare Server and DOS platforms, and you can activate a virus sweep of all servers and clients in a domain with one mouse-click.
Contact: Intel, Santa Clara, CA, 800-538-3373 or 916-377-7000; http://www.intel.com.
Enter 1005 on Inquiry Card.

Built-in HTTP and CGI functionality ends **FileMaker Pro**'s reliance on other software products for Web-related tasks. You can search, edit, and update records with a Web browser, and HTML templates facilitate the creation of custom intranet or Internet pages. FileMaker Pro 4.0 ($199 or $99 upgrade) supports storage of GIF and JPEG files in the database, and can send records in large, bulk e-mails. For general use, you can create FileMaker Pro files directly from Excel spreadsheets, and you can sort information in the main database according to various relationships and not just displayed by the dates files were created. This latest release also has new calculation functions and improved search features. It supports http, ftp, mail to, and file protocols for viewing on-line data.
Contact: Claris, Santa Clara , CA, 408-987-7000; http://www.claris.com.
Enter 1006 on Inquiry Card.

First Aid 98 ($39.95), the third-generation version of the PC repair software, has a newly refined interface, an Emergency Recovery System, and on-line help services. It lists any problems with a system in plain English, listed in order of severity. It can fix a problem automatically. If you don't trust the software to fix a bug on its own, you can fix stuff yourself, and the software will walk you through the steps, explaining them as it goes. It links to support sites to get answers it doesn't know, and with HTML support and FAQs, on-line data can be presented without needing to launch a Web browser. First Aid 98 traps error messages to make it easier to identify the source of a crash. If the program is unable to find the source of a glitch, it will contact the vendor by e-mail, sending a detailed message outlining the nature of the bug. The Emergency Recovery System checks the OS for signs of failure. First Aid 98 runs on Windows 95.
Contact: CyberMedia, Santa Monica, CA, 310-581-4700; http://www.cybermedia.com.
Enter 1007 on Inquiry Card.

Mapping

Travel Assistant Speaks for Itself

TRAVROUTE SOFTWARE'S IN-CAR NAVIGAtion assistant (12-channel GPS receiver included) not only guides you in your trip from door to door, it will talk to you as you drive. If you miss a turn or need to detour for traffic, CoPilot ($499) automatically provides a new route to your

destination, while continuing to provide verbal directions. CoPilot gives you detailed directions; all you do is input the addresses of the starting and destination points. In addition to CoPilot talking to you, you can talk back to it. You can speak to the program, commanding it to tell you where you have to make the next turn, for example.
Contact: TravRoute Software, Princeton, NJ, 888-872-8768 or 609-252-8197; http://www.travroute.com.
Enter 1004 on Inquiry Card.

Financials

Stock Quotes on Demand

DATALINK, A PROVIDER OF FINANCIAL AND personal information services that are delivered using alphanumeric paging and other wireless networks, enhances its QuoteXPress stock market service by adding Quote-On-Demand capabilities. QuoteXPress delivers stock quotes to your digital cellular phone or pager based on criteria you specify. With Quote-On-Demand, you can query a real-time stock quote feed and receive quotes over a wired or wireless phone. You can also get updates on market indexes (e.g., Dow Jones) and currency exchange rates.
Contact: DataLink Systems Corp., San Jose, CA, 888-603-5465 or 408-558-0800; http://www.datalink.net.
Enter 992 on Inquiry Card.

Networking

Pragmatic Virtual Networks

REMOTE NET-ACCELERATOR ($1999), from Traveling Software, lessens the burden of remote- and Internet-access clients on a network. File compression, disk caching, and buffering increase an application's response time over a virtual private network or RAS remote-node connection. During file transfer, only the parts of files that have changed are uploaded. Remote Net-Accelerator groups file requests and transfers files in blocks of information to control the network's burden.
Contact: Traveling Software, Bothell, WA, 800-343-8080 or 425-483-8088; http://www.travsoft.com.
Enter 1002 on Inquiry Card.

LAN, WAN, and VLAN Management

DIGITAL EQUIPMENT'S CLEARVISN 2.0 network management suite meets the demands of remote network administration. It features a new wizard for virtual LAN configurations, support for emulated LANs, and WAN services management. It supports a common database for storing device information. The suite consists of the Fault Policy Manager ($1495); the Intranet Manager, including WAN Services Management ($10,995); and the RMON Manager ($3495).
Contact: Digital Equipment Corp., Littleton, MA, 508-493-5111; http://www.networks.digital.com.
Enter 1001 on Inquiry Card.

improbable

Advances and Retreats in Computing

4-D images arrive! Electronic junkmailers get hosed! Life is good!

Something to STARE At

Forget 3-D because 4-D is here, literally here on this page. As you can see, it is stunning. Promises about 3-D stretch back more than a generation, but the reality was always disappointing, requiring that you wear colored lenses or that you buy very expensive and hokey viewing equipment. Some of the 3-D images also had the drawback of making you nauseous while you looked at them.

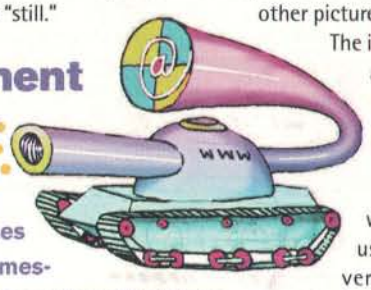
Arvin Papadopoulous, Inc., a tiny outfit from the high-tech wilderness of Boise, Idaho, has rendered all these 3-D efforts obsolete. The company is about to market a new kind of ink-jet printer that produces 4-D images on glossy paper. With this printing breakthrough, you can view *all* sides (including the inside) of every object in a picture. And you can also see the "fourth dimension," which is time. You can see the images move! And you don't even have to wear goggles!

This new printer allows you to vary the printing process so that the images appear to move in real time, accelerated time, or even slow motion. Ironically (and this example *really* demonstrates that life is a series of technological trade-offs), with this process, it is difficult to print an image that appears to be "still."

Admittedly, it takes a while to accustom your eyes to the Papadopoulous system. But once you "get it," you will be able to instantly see the full glory of any other picture of this kind. The image shown above (it appears to be three images, but really isn't) was prepared using a beta version of the 4-D printer. To view it, position your eyes about 80 centimeters from the paper and hold the page at a slight angle. Do not blink (that's important). If this is the first Papadopoulous image you have seen, it will likely take approximately 4000–4500 seconds before you see the picture for what it is.

Continuous Bombardment

Our recent story about e-junkmail generated numerous letters from readers who want to join the fight against e-spam. But e-junkmail perpetrators often disguise their true addresses by forging the message headers. Even if you find them, e-junkmailers are elusive. They move quickly (and often) from one Internet service provider (ISP) to another. What's needed is a way to find and track them as you lay down a stream of deadly fire to wipe them out. We speak metaphorically, of course.



An elegant program called Firehose (see the text box) does exactly that. Like e-junkmailers themselves, Firehose is relentless and inhuman. Some of you may ask whether this approach is overkill, in that the mail Firehose generates does itself soak up enormous bandwidth. Perhaps. But in this war to eliminate e-junkmail, it may be necessary to destroy the global village in order to save it.

new product

Firehose

Firehose is a simple Java applet. It's free, fun, and satisfying to use. The noble men and women (and skilled children) of the Department of Public Works maintain a list of the e-junkmailers' true addresses that is updated daily. Firehose sends a continuous stream of messages to every junkmailer who has sent e-junkmail to you and who is on the DPW's list.

The E-junkmailers' e-junkmail is jujistuistically turned back against them—and then some. The evil e-junkmail creatures cannot for long avoid Firehose's mighty stream.

Marc Abrahams is the editor of the Annals of Improbable Research. *You can contact him by sending e-mail to* **marca@improb.com.**

ILLUSTRATION: VICTOR GAD © 1997

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